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AN IMPULSE EXCITATION TRANSMITTER, DISTRIBUTIVE CAPACITY AND DEAD END EFFECT.

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Amateur Radio Stations Illustrated

A ROTARY QUENCHED GAP

EXPLAINED IN THIS ISSUE

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AMERICAN RADIO RELAY LEAGUE.

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EVERY amateur operator and every student of wireless owes a debt to Mr. Seelig who has translated Dr. Zenneck's "Lehrbuch der drahtlosen Telegraphie." This book has been a standard in Germany and now it is brought to America and translated for us. The book carefully covers all phrases of wireless telegraphy, from the fundamental principles to finished commercial apparatus. In the technical part you will find explanations which clear up every hazy point. Among the interesting features are the illustrations and photographs of dampened sparks. You can find out all about decrement. You see exactly how the ether waves travel. Once you read the book, you wonder how you did without it.

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Volume I JULY, 1916 No. VIII

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QST
A MAGAZINE DEVOTED EXCLUSIVELY TO THE AMATEUR

An Impulse Excitation Transmitter

By Ellery W. Stone
(Assistant Radio Inspector, Department of Commerce.)

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THE "Preliminary Report of the Committee on Standardization of the Institute of Radio Engineers" for 1913 defines "impulse excitation" as follows:

"The term applied to a method of producing free alternating currents of relatively small damping by means of actual or equivalent removal of a source of highly damped free alternating currents from the coupled secondary circuit. As a special case, the primary current may be very highly damped, but in all cases there must be in effect, a suppression of reaction between the circuits."

It is this "special case" with which we are concerned in the contemplation of the present systems of impulse excitation. However, the term "impulse excitation," as defined by the Standardization Committee, is quite broad, including as it does, all forms of quenched gap operations instead of limiting it to that particular form of quenched gap action with which it has of late been most generally associated. I refer to that form of transmitter in which the oscillations of the primary circuit are so abruptly damped out as to produce but single half cycles or impulses, causing a shock or impact excitation of the secondary circuit.

With the Telefunken and kindred quenched gap transmitters, the quenching action of the gap is confined to damping out the oscillations in the primary circuit when the current in the first group has become nil. In the strictly impulse excitation transmitter, the quenching properties of the gap are such as to damp out the current in the first oscillation or first half cycle before it passes thru zero, or at most, to prevent not more than one or two half cycles to follow, so that by far the greater portion of the energy is in the first half cycle. The difference between quenched gap excitation and impulse excitation, using the restricted meanings of these terms, is seen to be solely one of degree—of degree of damping of the primary current.

However, in practice, it is not customary to leave the attainment of high damping of the primary current to the gap alone.

The three constants in any alternating current circuit are resistance, R, inductance, L, and capacity, C. The proper value of R in the primary circuit is determined chiefly by the construction and action of the gap, that of L by the number of turns in the primary of the oscillation transformer, and of C by the capacity of the charging condenser.

From the formula $d = \frac{R}{2fL}$,

We may obtain $d = \frac{\pi R}{2\pi fL}$

$= \frac{\pi R}{\omega L}$

$= \pi R \omega C$

(where f is the frequency); or that the logarithmic decrement or damping of the free alternating current in a closed non-radiative circuit is a direct function of R and C and an inverse function of L. Hence, a decrease in the inductance and an increase of the resistance and the capacity of the primary will result in increased damping. A related conclusion may be drawn from Thompson's formula: namely, that when

$$R > 2\sqrt{\frac{L}{C}},$$

the current in the primary circuit is non-oscillatory. It may be seen from this formula as well, that the values of resistance and capacity must be high as compared to that of inductance to approach a condition of aperiodicity.

Mr. John Stone, in a paper entitled "The Resistance of the Spark and its Effect on the Oscillations of Electrical Oscillators," in the December, 1914 issue of the Proceedings, takes exception to the logarithmic decrement theory as applied to those circuits in which the spark resistance constitutes the major resistance of the circuit, and hence to those formulas quoted above. However, Mr. Stone states on page 322 of his paper, "A great many oscillation circuits, and probably the majority of oscillation circuits, are intermediate between the two classes mentioned, and I hope soon to present a paper giving the theory of such circuits in some detail." (The "two classes" referred to are those two types of oscillation circuits to which the logarithmic decrement and Mr. Stone's linear decrement theories of current decay are respectively applicable.) Consequently, until the advent of Mr. Stone's new paper one is in a quandary as to which theory to quote, but as far as the case at hand is concerned, there is little conflict.

In place of the Thompson formula

$$R > 2\sqrt{\frac{L}{C}},$$

Mr. Stone substitutes

$$R > \frac{2}{\pi}\sqrt{\frac{L}{C}};$$

but the same conclusions are to be drawn from his formula as from Thompson's, i.e., that to approach a condition of aperiodicity in the primary circuit, the values of resistance and capacity must be large as compared to that of inductance.

There is still another point to be considered. The absorption of energy from the primary by the secondary results in increased damping of the current in the former circuit; so that, other things being equal, an increase in the coefficiency of coupling between the two circuits will also increase the damping.

While L and C in the primary circuit remain constant, R does not, since R primarily is the resistance of the gap. For a quick discharge of the condenser, the resistance of the metallic circuit of the primary must be low, the surface of the gap large, the initial resistance of the gap high, and its recovery to its initial resistance rapid.

Before going into the details of a transmitter designed by the writer to incorporate these properties, a reference to previous work along these lines will be found of value.

From what information on impulse excitation the writer has been able to obtain, Mr. Roy E. Thompson, of the Kilbourne & Clarke Mfg. Co., Seattle, seems to have been a pioneer in this work in the United States at least, having designed and constructed an impulse transmitter as far back as 1910. The writer must acknowledge his indebtedness to Mr. Thompson for most of the preliminary data gathered on the subject in the preparation of this paper.

A wealth of material covering this subject is to be found in the December, 1913 issue of the Proceedings in a paper entitled "The Multitone System" by Dr. Hans Rein. The values of inductance, capacity and resistance in a typical primary circuit are given, together with an excellent theoretical exposition of the principles of the Lorenz and other systems, with numerous photographs showing their practical application. Not the least interesting is the appended discussion. Mr. Eastham's paper in the December, 1914 issue of the Proceedings will also be found to be of considerable bearing on the subject.

In the spring of 1913, the writer made some experiments on a rotary quenched gap of the Clapp Eastham type described in Mr. Eastham's paper. Recognizing the similarity between this gap and the Peukert gap, which latter employs a thin film of oil between the sparking surfaces, experiments were tried to see what effect would be realized by the introduction of oil into the Clapp Eastham gap. The only result noted was a decrease in antenna radiation, possibly due to excessive carbonization of the oil, and the experiments were

temporarily discontinued.

In the spring of 1915, the subject was again taken up, utilizing a larger and an improved type of gap to see what effect the introduction of a liquid hydrocarbon would have on the quenching properties of the gap.

The experiments were conducted as follows: From the simple formulas quoted above, and from the work of Dr. Rein and others, the necessity of large capacity, high gap resistance and low inductance were recognized, so a primary circuit containing one turn of inductance and enough capacity to bring the circuit to about 670 meters was utilized. The necessity for a transformer giving a flat topped secondary wave to simulate a D. C. wave has long been appreciated in operating impulse transmitters on alternating current. Accordingly, a 2 kilowatt, 60 cycle transformed with a secondary voltage of 2,500, so designed as to secure a maximum of leakage and of iron saturation, was built and used in this work.

It was not possible with the facilities at hand to note the number of oscillations in the primary, so it was found necessary to resort to the following method to determine the degree of damping. Probably the most significant phenomenon attending the operation of impulse transmitters is the absence of necessity for resonant tuning between the primary and antenna circuits. As a matter of fact, with true impulse excitation, it is almost impossible to measure the wave length of the primary circuit even tho uncoupled, a resonance curve of the primary being practically without a peak. By the substitution of a plain gap, however, the wave length of the primary may be easily measured; and this procedure was followed in the present case, the primary being tuned to 670 meters, as previously noted. With true impulse excitation, it should be possible to detune the primary and secondary circuits by any amount without a very great decrease of current in the secondary circuit and with the appearance of but a single frequency in that circuit.

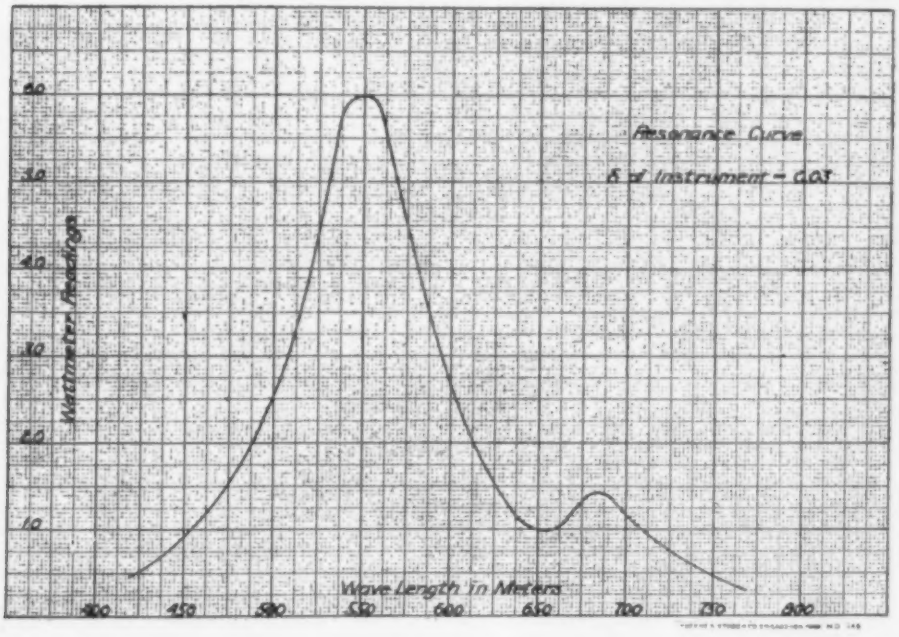


Figure 1

The evolution of the gap to realize this state of affairs may be found of interest.

The first experiment tried was to tune the primary and antenna circuits to resonance, as in the usual type of quenched transmitter, to note the damping of the current in the antenna circuit, which would give some idea of the quenching properties of the gap. The coupling was extremely tight, the single turn of primary inductance being placed directly over one turn of the secondary winding. With a motor speed of 1,800 R. P. M., the logarithmic decrement of the oscillations in the antenna circuit,

measured with a Kolster decremeter, was found to be 0.15, and exceedingly high value for a quenched gap, considering that the aerial employed was of the average ship type.

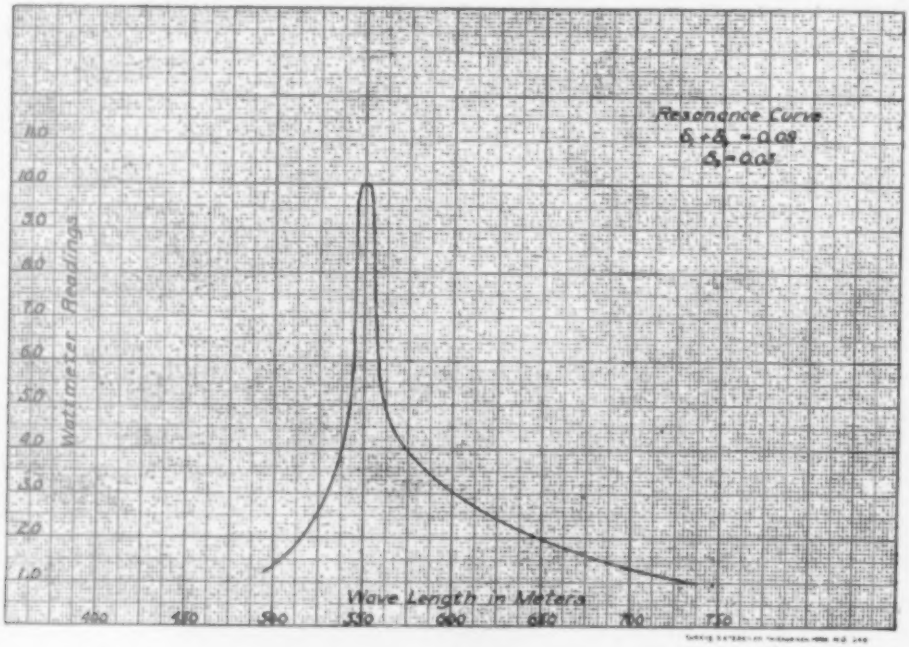
An increase of the motor speed to 3,400 R. P. M. reduced the logarithmic decrement to 0.06. From this, the quenching properties of the gap, without the introduction of gases, would seem to be a function of the speed of the revolving discharger. However, the impression should not be gathered that a speed below 3,400 would cause less damping of the primary oscillations or that a speed in excess of this would increase the damping. Good quenching, as determined by the logarithmic decrement of the secondary oscillations, was not obtainable until a speed of about 2,400 R. P. M. was reached. This gave a logarithmic decrement of 0.06 in the antenna circuit. From that speed up to 4,000 R. P. M., the limit of the motor, the logarithmic decrement remained constant at 0.06.

The next experiment was to detune the two circuits about 100 meters, with the result shown in the resonance curve, Figure 1. It was evident from the presence in the antenna circuit of the primary hump that impulse excitation had by no means been attained.

A light transformer oil was then introduced into the gap, flooding the gap completely, to see if the increased resistance would enhance quenching. But here, a mechanical difficulty asserted itself. Because of the presence of the oil (light as it was), the confined space in which the sectored plates revolved and the excessive churning up of the oil prevented the gap from coming up to speed with the size motor used, with the result that the sparking was irregular, the tone poor, and the condensers so overstrained as to cause puncture.

A gap was then constructed in which the sparking surfaces were mounted on an open frame instead of being enclosed in the usual casing. This open frame was then lowered into an earthen receptacle into which oil was poured. It was hoped by this new construction to overcome the friction caused by the violent disturbance of the oil in so confined a space. The gap was more nearly brought up to speed, as had been expected, but the oil was freely thrown from the container, and air bubbles found their way into the sparking area with consequent explosions which caused the sparking to be so irregular as to make quantitative measurements with the decremeter impossible.

It was decided to return to the original



type of enclosed gap, using a much larger motor to bring the gap up to the desired speed. But the largest motor at hand, 0.75 horse-power, failed to effect this; so the oil was removed by a pet-cock at the base of the gap and alcohol substituted in the hope that the lighter liquid would cause less friction. However, alcohol, when subjected to a potential difference of 2,500 volts across a distance of a few thousandths of an inch, exhibits slight insulating qualities, as was discovered; and leaked so badly as to prevent the passage of a spark.

The alcohol was accordingly allowed to run out of the gap, and measurements were again taken to confirm the results of the second experiment—to see if it were still impossible to detune the circuits without the generation of two frequencies in the antenna circuit.

The same results as shown in Figure 1 were again obtained. To see if the gap were inadequately cooled, the spark was allowed to run five minutes, and when a resonance curve was taken at the expiration of that period, the curve shown in Figure 2 was obtained, showing a logarithmic decrement of 0.06.

The explanation was at once apparent. The pet-cock at the base of the gap was so mounted as to leave a small quantity of the alcohol in the base of the casing or housing. This, because of the heat of the spark, vaporized; thus enhancing the quenching properties of the gap. This action has been previously noted by Scheller, Poulsen, Eccles and Makower, and others.

Additional resonance curves were taken to check the first reading, the spark being allowed to operate continually. However, after ten minutes, sparking in the chamber became irregular, and was replaced by occasional and later by continuous sparking across the condenser safety gap, the electrodes of which were separated a distance of 1.5 centimeter. It was of course obvious that the pressure of the alcohol vapor within the chamber had been so greatly increased by the continuous sparking, and consequent liberation of heat, as to reach a dielectric strength sufficiently high to prevent the passage of the spark.

To reduce the pressure within the gap, and thus to allow sparking to take place, the pet-cock was opened and a small quantity of the vapor allowed to escape. The high pressure within the spark chamber was clearly demonstrated by the almost explosive force of the escaping gas. Sparking again occurred but stopped after a few minutes because of the pressure again rising to too high a value. This condition was relieved by opening the cock a second time. The vapor was purposely ignited this time and burned quietly a distance of several centimeters from the opening, exhibiting by the great heat and colorless flame the presence of what appeared to be almost pure hydrogen.

The necessity for an automatic device to provide for a reduction of the gas pressure when it should reach too great a value was obvious. Accordingly, the pet-cock was removed, and an adjustable, poppet, release valve substituted. When the gap was again put into operation, this also served to handle the first explosion caused by the admission of air into the chamber when making alterations on it. This preliminary explosion is encountered in the operation of Poulsen arc transmitters, when air has been admitted

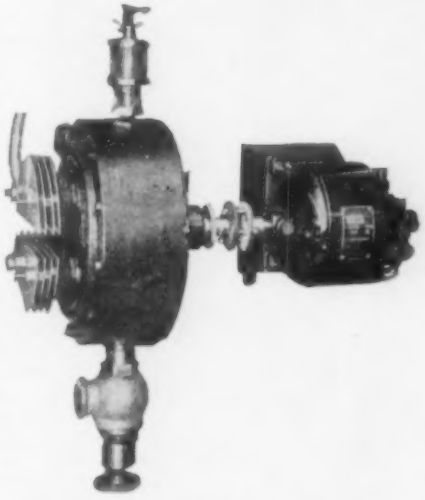


Figure 3

into the arc chamber thru the replacement of a carbon.

The release valve was set so as to allow vapor to escape when the pressure reached a value beyond which a further increase in pressure would prevent the passage of the spark.

The quenching properties of this gap are thus seen to be wholly within the control of the operator or engineer, a unique feature, which, to the writer's knowledge, has not been used before.

The vaporization of alcohol or other hydrocarbons in a quenched gap is by no means a recent innovation. Poulsen, Scheller, Rein and others have vaporized the alcohol directly within the gap, and the Japanese have blown alcohol vapor, formed by

passing a stream of air thru a sponge saturated in that liquid, into their quenched gaps. However, it is believed that the working of the hydrogen vapor within the gap at such an extreme pressure as to prevent sparking therein, except by automatic reduction of same, is a feature hitherto unused, and which is solely responsible for the efficient performance of this gap for impulse excitation work.

The quenching properties of the usual quenched gap depend greatly on the extent to which the gap is cooled. With the gap herein described, the more heat generated within the gap, the greater is the gas pressure formed, so that the one action automatically compensates for the other. Cooling of the spark discharges themselves is to be desired, and this is effected as far as the stationary plate is concerned, by mounting radiating plates on the posts holding the plate to the casing.

Figure 3 illustrates the gap proper. The alcohol drip cup is shown at the top of the gap. This is equipped with a pressure equalizer, a tube running from the inside of the spark chamber to the top of the cup to insure a steady flow of alcohol. With such an arrangement, it is necessary to keep the cap, by which alcohol is poured into the cup, air-tight. The safety release valve is shown at the bottom of the gap. As previously explained, the hand wheel on the valve is adjusted so as to keep the vapor pressure just below that value which prevents sparking. A rubber tube, not shown, serves to conduct the vapor from the mouth of the valve, acting as an exhaust pipe. The complete casing is of iron, leads being carried into the gap thru bakelite bushings. The construction of the stationary and movable plates is similar to that of the Clapp Eastham gap.

Figure 4 shows the complete 2 kilowatt transmitter. All wiring is done within the frame itself. Four variations of primary input are possible, being controlled by the switch at the right of the panel. At the rear of the panel are mounted the closed core transformer and the condenser. The latter is built up in one unit, using copper sheets with thin Belgian picture glass for dielectric, the whole impregnated in a non-hygroscopic compound. The low secondary voltage effectually prevents puncture, but the condenser is so mounted as to permit of the immediate substitution of a spare unit should any unforeseen accident to the condenser occur.

A closer view of the oscillation transformer is shown in Figure . Since tuning between the primary and secondary circuits is not necessary, the primary inductance is made non-adjustable. In the set shown, it consists of two turns. The greater coupling gained by using two turns instead of but one increased the antenna radiation, and did not seem materially to effect the damping of the primary current, the increased absorption by the secondary circuit probably compensating for the less favorable effect of increased inductance in the primary.

Since all of the energy is to be delivered in one half cycle, or as nearly that as possible, it is necessary to have the resistance of the metallic circuit as low as practicable. and to have as much of the primary inductance as possible effective in inducing energy in the secondary. One end of the primary inductance connects with the gap as shown,

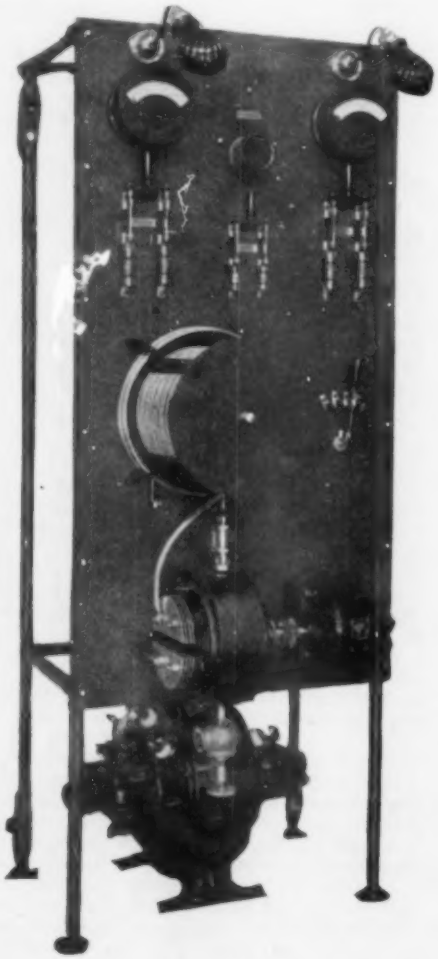


Figure 4

the other end to the condenser thru merely the thickness of the panel, 2.5 centimeters. The remaining lead from the gap to the condenser is about 8.0 centimeters in length.

The antenna loading inductance is mounted independently of the panel. This inductance is wound in the usual helical form and taps are taken from this to four plugs marked $\lambda=300$, $\lambda=400$, $\lambda=500$ $\lambda=600$, respectively. The position of these taps is of course determined by wave meter, being dependent on the fundamental wave length of the antenna. This inductance is mounted so as to permit of immediate change from one wave length to another. Since the primary wave length remains constant for any wave length it is desired to radiate from the antenna circuit, it is only necessary to insert the aerial-lead handle in any of the plugs mentioned.

In operation, the tone of signals received from this transmitter is clear and piercing altho accompanied by a slight "feathery" tone, to use operator's nomenclature. This is probably due to the fact that discharges cannot always take place when the gap sectors are opposite each other, due to the non-synchronous revolution of the gap. However, this slight roughness is by no means displeasing; and even with local signals, the impulse group freqency of about 1,000 is not accompanied by the 60 cycle supply tone.

An antenna radiation curve of this transmitter is shown in Figure 6. In a true impulse excitation transmitter, other things being equal, one would expect from Dr. Rein's paper, that the radiation would be constant, irrespective of the difference in wave length between the primary and antenna circuits. In other, words, with the primary adjustment fixed, a curve of radiation current readings, plotted against different wave length settings of the antenna circuit, should be a flat linear curve, as against the sharp peak radiation curve of a resonant quenched transmitter. In Figure 6, the point at $\lambda=300$ is not significant, since the fundamental wave length of the antenna necessitated the interposition of a series condenser in the antenna circuit for this wave length setting with the usual consequent decrease in radiation. The slight rise in the curve from 400 meters upward may be due to the diminishing antenna resistance at longer wave lengths just as much as to the fact that an approach to 670 meters in the antenna circuit places the primary and antenna circuits in resonance. This curve is similar to curves previously taken of the impulse excitation transmitters of the Kilbourne & Clark Mfg. Co.

Experiments were also conducted to observe the effect of shunting a tone circuit across a gap, employing smooth discs in place of the usual sectored discharges. The results were interesting. Without the tone circuit the note obtained was a smooth, hissing one; signals being received far better on a Poulsen tikker than with the crystal or audion detector. The impulse frequency is above the limit of audibility, and that the spark is audible at all is due to the fact that the condenser is charged with alternating current instead of the direct current which should be used for ideal impulse excitation. This results in a somewhat irregular impulse frequency, due to the fact that the charging E. M. F. passes thru the zero point 120 times per second and also to the fact that the secondary wave of the transformer is probably not a perfectly rectangular flat-top one.

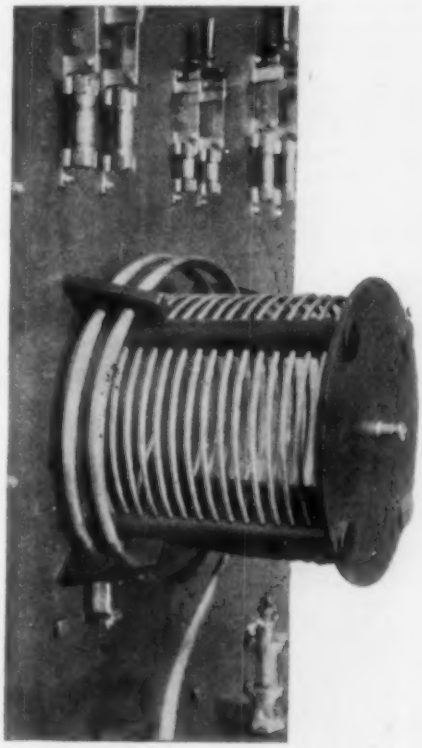


Figure 5

The quenching properties of the smooth gap seemed to be greater than those of the sectored gap, as evidenced by curve b of Figure 7. This curve is a resonance curve of the antenna circuit, the logarithmic decrement being 0.052 as against the 0.06 de-

crement of the curve in Figure 2. The increased decrement is probably due to the larger gap or discharge surface.

A tone circuit, the capacity and inductance of which were determined by trial, was shunted across the gap, causing increased damping of the primary current as shown in curve a of Figure 7, the decrement of which is about 0.050. The absorption of energy by the tone circuit apparently assists in increasing damping in the primary circuit in the same fashion as the absorption of energy by the antenna circuit. While the antenna current was reduced about 1.5 per cent. by the use of the tone circuit, the height of curve a in Figure 7, when compared to that of curve b, shows that the

to observe this.

The tone circuit was then tried in conjunction with the sectored gap, but the resultant tone was poor. Certain speeds of the gap were found which tended to improve the tone greatly, but at no time was the note as clear as when the tone circuit was omitted. (These critical gap speeds were probably those which placed the impulse group frequency in resonance with the oscillation frequency, or a multiple thereof, of the tone circuit.)

On the whole, of all the experiments herein described, the best results were obtained using the smooth discs and the tone circuit. The addition of the tone circuit did not

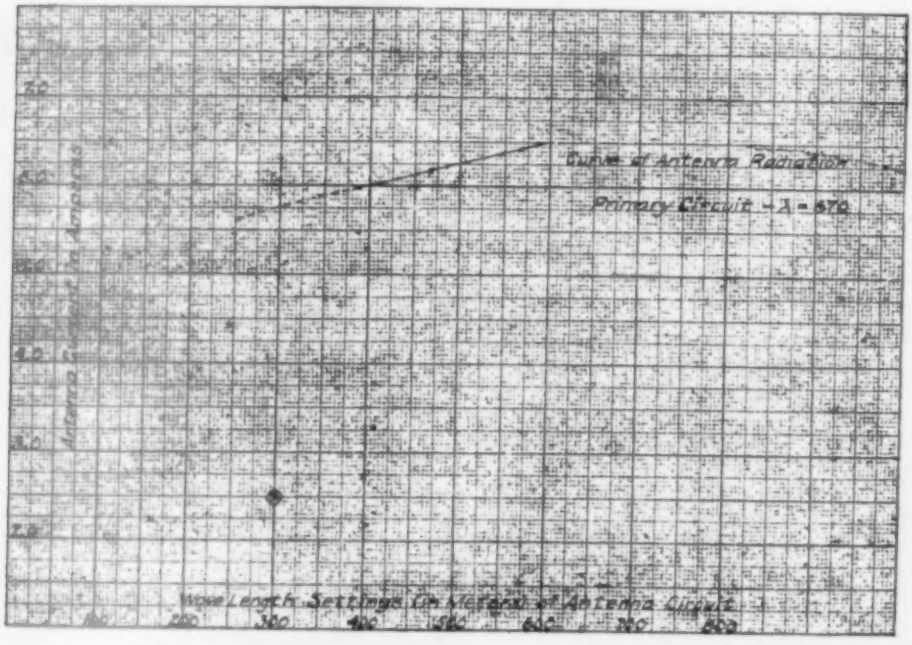


Figure 6

energy at the oscillation frequency of the antenna circuit is slightly greater. (The coupling between the antenna circuit and the decremeter was constant in taking the data for both of these curves.)

Due to the alternating current, the note obtained with the tone circuit was not musical, but nevertheless was shrill, clear and piercing. At a receiving station, signals with the tone circuit were many times louder than without this circuit. Possibly the note may be improved by the use of a higher frequency alternating current, say 500 cycles. Experiments will be undertaken later

change the appearance of the transmitter as shown in Figure 4, the additional inductance and capacity being mounted on the rear of the panel.

Ideal "impulse excitation," as opposed to the usual quenching gap phenomena, is described. The best conditions for impulse excitation are explained.

The development of a rotary sectored gap of small separation operating in a hydrocarbon atmosphere is considered. A 2,500 volt, 60 cycle transformer charges a large capacity which discharges thru the gap and

a small inductance. Effective impulse excitation requires about 3,400 R.P.M. of the gap or more. Using alcohol vapor, an adjustable pressure, (safety) valve must be fitted to the gap to prevent excessive pressures which raise the gap voltage inordinately.

A complete 2 kilowatt transmitter of this type is described. The antenna circuit need not be in tune with the closed circuit; hence wave changing is accomplished by merely shifting the antenna lead along the antenna loading inductance. The radiation remains constant over a wide range of wave lengths without closed circuit tuning.

Smooth-disc gap experiments are also described.

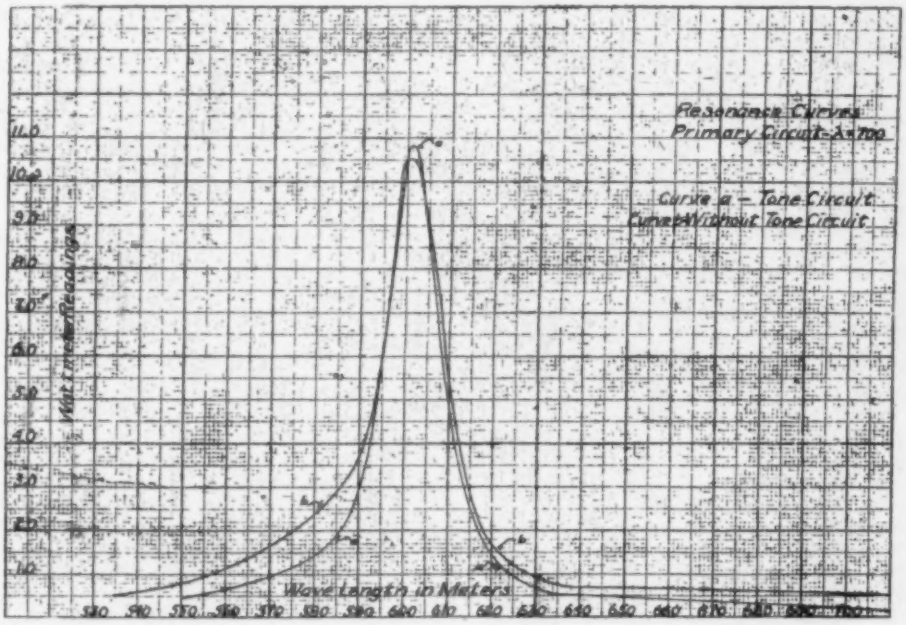


Figure 7

DISCUSSION.

Roy E. Thompson (communicated): Mr. Stone's excellent paper is of particular interest. He has shown very good judgment in attacking the problem along the line of the development of a spark gap which will effectively handle the tremendous currents in a circuit such as must necessarily be used in the production of pure impulse excitation.

Even tho it is assumed that the decrement of the impulse circuit is a logarithmic one (and therefore, that when

$$R > 2\sqrt{\frac{L}{C}},$$

no oscillations will occur in accordance with the Kelvin theory), or that no oscillations will occur so long as

$$R > \frac{2}{\pi}\sqrt{\frac{L}{C}};$$

(as pointed out by Mr. John Stone); or tho we assume that the damping of the energy in the impulse circuit is intermediate between that of the logarithmically and linearly damped circuits, we must still keep the inductance in the circuit as small as possible, and the capacity as great as possible; for in order to secure a fair degree of efficiency the damping in the closed circuit must be due to the lack of inertia as represented by the inductance of the circuit and to the rapid transfer of energy from the impulse to an oscillating circuit.

It will easily be seen that if the damping of the impulse circuit is due to the resistance of the spark gap, great heat losses

must necessarily result, which would not result if the damping was due to the other two causes pointed out above. Therefore, the ideal gap to be used in an impulse circuit is one that has extremely low resistance during the discharge, but which regains its initial resistance almost instantaneously after the passage of the discharge.

It is my opinion that Mr. Ellery W. Stone has more nearly approached the attainment of this ideal gap, than has any other worker along these lines.

In 1910 I designed and constructed an impulse transmitter using a discharger in the form of a re-constructed Poulsen arc, the electrodes being of copper and aluminum with parallel circular faces of approximately 2 inches (5 cm.) in diameter and placed in a transverse magnetic field, the entire gap being contained in a chamber into which alcohol was introduced and vaporized in a manner entirely similar to the present Poulsen arc method. However, instead of using an arc, I used a pure condenser discharge in the form of a spark. The capacity used was a one microfarad paper condenser and the inductance was probably between 500 and 1000 centimeters as afterwards calculated. With this device I was able to radiate widely different wave lengths without changing the characteristics of the impulse circuit.

In 1914, I modified the above design and interested the Kilbourne & Clark Mfg. Co. of Seattle, Wash., in its manufacture. Since that time more than forty of these transmitters have been put into commercial use on the Pacific Coast by this Company.

It might be of interest to call attention to the necessity of keeping the impulses in the closed circuit properly spaced in order to prevent the resultant wave trains in the antenna from over-lapping and interfering.

As the impulse frequency is a function of the charging potential, the capacity of the impulse condenser and the breakdown potential of the gaps used, it will be seen that even with afixed capacity and a fixed gap; raising the charging potential may result in an impulse frequency which will cause wave train interference in the antenna.

The writer has worked out a formula by which the maximum permissible impulse frequency for use with an antenna with any decrement and wave length may be quickly determined:

Let δ be the decrement and λ the wave length of the antenna circuit.

Then $$N < \frac{\delta 10^8}{\lambda}$$

where N is the frequency of the impulses in the closed circuit; or

$$T > \frac{\lambda}{\delta 10^8}$$

where T is the minimum time which must elapse between any two consecutive impulses.

The expression

$$\frac{\lambda}{\delta 10^8} = T$$

will be found approximately correct when T represents the time of duration of the effective energy in a train of oscillations in an antenna circuit.

I hope at some time, to present a paper dealing with the development of the impulse transmitters manufactured by the Kilbourne & Clark Mfg. Co. and to describe certain phenomena encountered in the development of this apparatus, which I believe will prove of interest to radio engineers.

Mr. Stone's paper is undoubtedly a valuable contribution to this most interesting subject and it is hoped that he will give us the benefit of his further contemplated the benefit of his further contemplatetd

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IMPORTANT ANNOUNCEMENT

Every member of the American Radio Relay League will be interested to know that arrangements have been concluded whereby all papers presented before The Radio Club of America will be reprinted in QST. No other publication will have the right to publish these important articles and the discussion which accompanies them.

This arrangement is one which works advantageously to both the parties interested, since it provides The Radio Club of America with its papers and discussion in printed form and it also provides the amateur of the entire country with the result of the study and work on the latest radio developments. QST is growing by leaps and bounds and another year will see it and our Relay League one of the important radio institutions of the country.

The first paper to appear will be Paul F. Godley's article presented on June 9, 1916 entitled **"Amplications of the Audion."** This will cover the uses of the Audion as Detector, Amplifier, Oscillator and Generator for Radiotelephonic Transmission with diagrams, data, curves and specifications in detail.

Distributive Capacity and Dead End Effect

By Harry Sadenwater.
Copyright, 1916 by Radio Club of America.

IF an inductance is inserted in an oscillating circuit a difference of potential will be found to exist across its terminals due to its impedence.

There will also be a difference of potential between turns; therefore, electro-static lines of force will pass between them. Electro-static energy is stored between a turn and the neighboring turns and, since capacity is necessary to store electro-static energy, we have in effect a capacity scattered or distributed along the whole length of the coil. (Fig. 1).

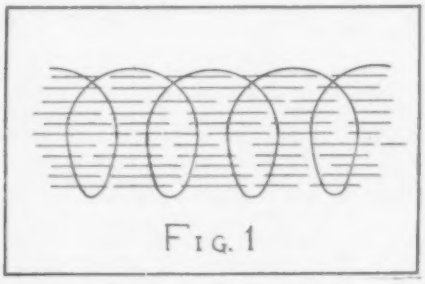

FIG. 1

This capacity has several effects, sometimes desirable and sometimes not. A coil cannot be considered as a simple inductance but account must be taken of this distributed capacity which may be regarded or treated as an equivalent capacity shunted around the true inductance.

One effect is that if a coil having a marked distributed capacity is used in conjunction with a condenser, forming perhaps the closed circuit of receiving set which is to be used to tune to low wavelengths, it may be found that the distributed capacity interferes to some extent in this way. The wave length of the circuit would not be equal to:

$$\lambda = 59.6\sqrt{L_{cms} \cdot C_{mfds}}$$

where L is the true inductance of the coil and C is the capacity of the condenser but would be equal to:

$$\lambda = 59.6\sqrt{L_{cms} \cdot (C + C_d)_{mfds}}$$

where L and C are as before, and Cd is the distributed capacity. Cd might easily be more than C when tuning to low wave lengths and the circuit would not develop the desired highest potential, say in connection with an audion detector.

Another effect is that if a coil having distributed capacity is excited, perhaps by an aperiodic buzzer circuit it will oscillate quite freely and powerfully at a period determined by the familiar equation

$$T = 2\pi\sqrt{LC_d}$$

L being its effective inductance and Cd being the distributed capacity, both of course being in the same units.

Also it follows the wave length at which this coil will naturally oscillate will be given by

$$\lambda = 59.6\sqrt{LC_d}$$

L, its inductance in cms. and its capacity Cd being in Mfds.

This eads the way to a more or less simple method of measuring the distributed capacity. The effective inductance may be measured by comparing it with a standard or calculated using the formulae furnished by the Bureau of Standards. Then the coil may be set oscillating, conveniently by a highly damped impulse from a buzzer and its wave length measured with the aid of a wave meter.

Now by transposing the terms of the equation already given,

we get

$$\lambda = 59.6\sqrt{LC_d}$$

$$C_d = \frac{\lambda^2}{59.6^2 L}$$

the distributed capacity of the coil in microfarads.

Another method of measuring the distributed capacity of an inductance is due to Drude. The following formula, using the

physical dimensions of the coil was taken from Professor Goldsmith's article in the Wireless Age:

$$C_d = 2Kr\,\frac{2+\frac{h^2}{r^2}+\frac{r^2}{h^2}}{10+4\frac{h^2}{r^2}+3\frac{r^2}{h^2}}$$

where h equals the length of coil in cms., r equals radius coil in cms. and kisa constant due to the length of the coil divided by the diameter and ranges from .3 to 1.8 with an air core inductance.

h/2r	k	h/2r	k
6	1.81	0.8	1.10
5	1.64	0.6	1.07
4	1.47	0.4	0.94
3	1.37	0.2	0.69
2	1.26	0.1	0.49
1	1.12	0.05	0.28

There is still another simple method of measuring the distributed capacity; namely, to shunt the coil with a calibrated variable condenser and then exciting the circuit with a wave meter and plotting the wave lengths squared against the capacities at the various frequencies. A straight line is obtained which instead of starting at zero capacity will intersect the base at a certain minus value which would be the distributed capacity (effective) of the inductance.

It is interesting to note that when we set a coil oscillating at its natural period it behaves exactly like an Hertz Oscillator or the aerial of a station with its image, while the current value in a closed circuit at a given instant is the same all around, the current distribution along the oscillating coil L would be as shown, Fig 2 the greatest current value being at the center while the greatest potential would be present at the ends. That high potential at the end should look well to the users of the audion.

Now for the Dead End Effect.

If we had an aerial arrangement as in

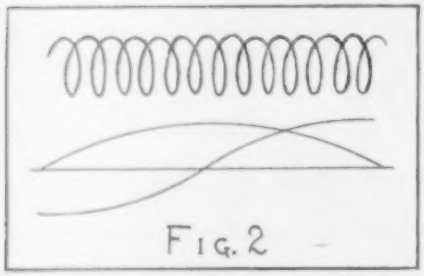

FIG. 2

distributed capacity in series with the antenna, we have actually, two closely coupled the figure, Fig. 3 using part of a coil having circuits. One the antenna, part of the coil and the ground; the other the entire coil shunted with its distributed capacity.

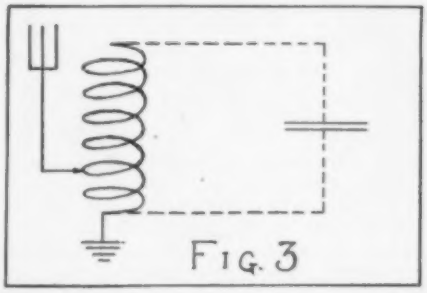

FIG. 3

Really it is a system of two degrees of freedom. The coil with its distributed capacity may easily have a natural wave length of 600 meters, the wave tuned to. This coil or secondary circuit then seems to absorb quite nearly all of the energy and the detector gets none. I will have to ask you where the energy goes, but it goes all right. I2R perhaps?

In the secondary circuit the same thing happens. For example take the secondary of the United Wireless Type E Receiver. The coil is tapped off into ten sections and to tune to 300 meters; one section is used with a small variable condenser across it. The whole coil itself oscillates at a wave length of 275 meters. You can easily imagine the beautiful distance work you will be able to do with this coil absorbing most of the energy.

Just in this respect I think the amateur would find greatest interest in the dead end effect. The ordinary practice is to buy a coupler that will tune from below 200 meters up to and sometimes over 2,000 meters. To get the longer wave lengths, it is necessary to have a pretty good sized secondary coil and on measuring a few, I found that the fundamental wave length of most of them varied from 200 to 300 meters,—just the waves the amateur uses. Now do you understand one of the reasons why you get no distance work on two hundred meters? When you go up to 500 meters, the coil is not in tune with the received signals and absorbs much less energy. To give an example or two at the East Side Y. M. C. A. we have a secondary which has 725 inches of winding 3.5 inches in diameter wound with No. 28 S. C. C. Its natural wave-length is 290 meters,—much hope to tune to a 300 meter wave!

The secondary of the Type E Tuner oscillates unloaded at 275 meters having 3.5 inches of No. 28 S. S. C. winding, 3.25 inches in diameter.

A loading coil used for long waves has

25 inches of winding of No. 20 S. S. C. 5.6 inches in diameter. Its natural wave length is 570 meters. Some larger coils or rather inductances also are 25 inches long and 5.6 inches in diameter but are wound with No. 28 S. S. C. wire, having something like 1750 turns and a natural wave length of 1600 meters.

Some people think it well in order to eliminate this dead end effect, to short circuit the unused part of the inductance. Under certain conditions this is all right, but at other times it is all wrong. L. Cohen, in the Electrician, January 23, 1914 discussed this point and showed that if an inductance coil of a hundred turns had ten of its turns forming part of an oscillatory circuit and the remaining ninety turns were shorted, there would be practically no loss; the current in the closed circuit being the same as if the ninety turns were not there.

But if seventy of the hundred turns were in the closed circuit and the remaining thirty turns were shorted, only 34 per cent. of the current in the closed circuit without the shorted end would be available.

In the extreme case of using ninety-nine and shorting one turn about a third of the primary energy is available. Though not in place I cannot help but point out again that this is where the great disadvantage of the slider contact of tuners comes in. Most sliders on the small wire inductances of tuners touch two turns at the same time,

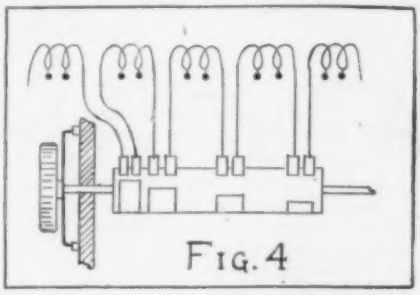

FIG. 4

the case in mind. Try this out for yourself. Tune in any station, Cape Cod perhaps, so as to get good loud signals, then wind a single turn of bellwire around the primary. Generally you will find that no amount of tuning will bring in his signals readable.

If different inductances cannot be used for different ranges of wave lengths, it is probably best to open the unused coil circuit several times, so as not to have sufficient inductance in any of the sections to tune naturally to any of the wave lengths received. This is what is done in the new Marconi Type 101 tuner, that can be tuned to all waves from 100 to 4000 meters. The switch arrangement is as shown.

THE INSTITUTE OF RADIO ENGINEERS

The monthly meeting of The Institute of Radio Engineers was held June 7th in the Engineering Society's Building, New York City. A paper on "Arc Oscillations and Coupled Circuits" by Professor Hidetsugn Yagi of the College of Engineering at Sendai, Japan was presented. The efficient transfer of energy from the primary to the secondary and the production of overtones was fully considered. The paper was illustrated by many interesting experimentally determined curves.

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THE RADIO CLUB OF AMERICA

The Radio Club of America held its monthly meeting on June 9th in Columbia University, New York City. Mr. Paul F. Godley presented a paper on "Applications of the Audion." Mr. Godley was especially fitted to discuss this important subject as he has made a careful investigation of the field. This paper will be published in full in an early issue of QST and the readers will bring some new work of the Radio Club of America. All these articles handle most important practical questions in a manner which interests us all.

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CITRUS BELT RADIO ASSOCIATION

This organization of the amateurs in and about Pomona, Cal. has been in existence for about a year and is steadily growing in membership. The association owns its own club house which is located at 350 Illinois Street, Pomona, Cal. Meetings are held every Thursday evening. All applicants for membership must pass an examination in general radio subject before being admitted to the association.

The Officers at present are, Howard G. Gates, Pres., Otto B. Tyler, Vice-Pres., Herbert Clewitt, Sec. and Treas., H. P. Gilbert, Chief Operator.

OO

The man who drew the picture for Page 119 of the May issue of QST was in error. I have it from an ex-commercial operator that QRN is produced by the Chinese Government set sending the native language. This exonerates the Satanic Majesty.

"Portable Station SK"

By The Operator

A BICYCLE does not steer well when six dry cells are strapped over the rear wheel, and when the handle bars carry a board with a spark gap and a quarter inch coil that has a savage way of jumping on your thumb at the moment you can't let go—then—then I say —there is but one joy in bicycle riding and that is that the other fellow with the receiving set is probably having a worse time. You have heard him speak feelingly to the coupler as it smashed his thumb and just now he is going back after the phones and detector minerals that the tool bag quietly dropped on the road. Naturally, he didn't notice this till reaching the top of a hill as steep as the price of audions and as long as Sunday afternoon.

You free one hand to swat the fly that is bathing in the salty river down the back of your neck. Bad judgment, old man, bad judgment; the coil sees an opening and jumps on your thumb with both feet. There is no sense in jumping after you are struck, but it is human to use an injured thumb to plug the place whence the purely automatic streak of fire freckled language has just issued. Being human you do this; the wheel, being inhuman, braces it's front feet against a clod and sends you into the ditch. Anathema! I got up (oh, I might as well admit it) and took a quick look down the road. Hooray! Bill hasn't seen it; lucky for him, for I was in the proper mood to slay any and all scoffers.

After this it gets hotter and hotter till we stop sweating and ooze superheated steam, while this maniac road twists around to hunt up the steepest hills and the sandiest hollows, meanwhile dodging every well in Douglas County.

Here we are at last; three miles airline by the map, six by the cyclometer and ten —no less—by my feelings.

"Here" is a cowpasture with no mast in sight but the grandfather of all cottonwood trees. A quick calculation shows that you can not reach nearly enuf around a five foot tree trunk to shin it and as I turn to Bill he hastily says: "I can't climb that."

"Oh well, give me the aerial and I'll put it up."

The aerial is a spool of 26 enamel and with a piece of string as insulator. Now, when you have to, you can climb such things, though I leave it to the fraternity if you know how it's done, even while you're at it. There is a wind too, a Kansas hot wind that you fellows on the wrong side of the Mississippi wouldn't understand if I made you a diagram. If you are insistent, spend fifteen minutes in the nearest boiler room and multiply by three.

Just the same, we got the aerial anchored some forty feet up and stretched it out 300 or 400 feet, threw thirty feet of wire in the nearest pond for a ground and began to call "PB."

"How does he come?" inquires Bill for the definite purpose of irritating Me.

"He does not."

"Let me have it," and with that he grabs the phone without waiting for an answer. This habit has riled me before, so I hang the phone and remark—

"Keep your shirt on."

"Well, I can get him" — grabbing the phone again.

"Say! give me a chance."

"Well, but—"

"S H U T U P."

Silence—

"Got him yet?"

"No. I'll send you notice when I hear him."

More silence. Business of thinking evil thoughts of the inventor of the galena detector.

At last! An adjustment! And also static; all the kinds of static there are, big static that booms, and middle sized static that pops and little static that

crackles, and unclassified static that hisses. Surely the Chinese government has a lot of sending to do. Pity but a fellow could read their stuff.

"Here he is."

"About time."

"Say, can you hear people when they aren't sending?"

"Want me to call him?"

"Wait till he gets through. Now go ahead."

Then Bill pounds the Heinz tomato tin key. This is in the days of Morse and the sending is disturbed by an argument as to the number of dots in a P. Each fellow is sure that the other is a nut or possible a fool.

"Shh—Here he is."

"Gimme that pencil—QUICK."

"SK SK SK SK PB SK SK SK SK PB Prrrrrr pop brrr (this from the Chinese station) et you Pop pop POP) POP-POP! oud but your tone.

"How's he coming in?"

"S H U T U P."

"Sometimes. How do you get Warrrr pff piff pop G A GA."

"What'd he say?"

"Says he gets us good but the tone is poor. Wants to know how we get him.

"Tell him good."

So that is buzzed off. This sort of thing goes on for an hour. At the end of that time you have learned that PB gets you well, good and fair, that he has lots of static, that they are going to have fish for supper, that the tone is bad part of the time and worse the rest and are you going to move soon?

You are and do—two miles west to schoolhouse No. 37. It is a curious fact that no schoolhouse ever had a good well. This pump looks well, and acts well, but there is never a cup and the water tastes like death, corruption, and decay—likewise

old leather and iron pipe.

"PB PB PB SK PB PB PB PB SK GA."

"Here he is first thing. Don't tell me I can't pick 'em up." I feel gracious enuf to turn the phone over to Bill and take the key.

"What's he say."

William has been aching for this chance.

"S H U T UP" all in capitals too.

There is nothing to say. I say it. And I'm glad all over when Bill backs into the aerial and a pale blue spark reaches over and touches him on the shoulder. He makes a hurried attempt to walk through a live wire fence and uses up several reels of saffron and magenta language in addressing the coil.

"Look here. That's a good coil and I won't have you blackguarding it that way."

"Oh, crash your good coil."

"Calm yourself."

"Go to. Here's PB again—he says we have fine tone now and come in strong. Wants to know how far we are."

"Tell him he's loud and we are three and a half miles airline and about fifteen by road."

"PB wants a repeat."

"PB wants another repeat."

Says the coil—"Say what's the matter up there. Thought we came in good."

"He says we do but his mother is running the sewing machine."

"He says OK this time and wants to know if you have any message."

Now that was an idle question. Again I leave it to you, fellows; did any portable ever have anything to say?

The coil—"No. We are coming in half an hour. Try changing coupling."

"Why?"

"Listen!" I said—we are com-well, for the Love of Mike, Bill, how often do your propose to back into that aerjal?"

Bill makes a face that fits with green persimmons and doubles up to the remark "Good Gosh, that thing hurts."

"What? That little coil?"

"Yes, that little coil. Just stick your head against that aerial and let me shove the key and see if that little coil don't hurt."

"But listen, Billy, if you don't like it why—weeel—there you go again. Come! Take a good grip and let me give you all you want, so you don't have to keep coming after more."

Silence with asterisks and crash words in it.

"He says—what's the matter out there. Why don't you go on?"

The coil—"I said-that-we-are coming-in-half an hour. Will you or will you not change your coupling?"

PB—"Come for what?"

Supper.

"What?"

"Supper, chow, grub, essen, sabe?"

"Say, what are you talking about. You said something about warrr pst pfff pfff pop coming crack crack crack pop Rrrrr in half an hour."

OHDAMIT. Let's try once more.

The coil—"Coming half hour. Will stick here that long. Get it?"

"OK OK OK OK"

After that we can't raise PB although we take turns pounding the key till the batteriest die. We also "run" the connections and adjust the detector twenty or thirty times but it is strictly NIL.

Finally, I get up and start to pull the aerial down.

"Here; what's coming off?" objects Bill.

"You can't raise PB."

"Why can't I?"

"Look up the road—" coming down the hill at about twenty miles per hour is a wheel whose rider is unmistakably the operator of PB.

The Spark Coils

By Edgar Felix

As you are doubtless aware, there are still many amateur stations using one and two inch spark coils, who make the ether tremble with all kind of squawks, scratches, squeaks and groans. Could you devote some time and space to QST to the assistance of these, to better the note of their coils by having someone write a good article on the mechanical interrupter?

There are many disadvantages to this instrument, but several successful ones are now in operation. 2IE and 2CI of New York City (Mr. Faraon and Mr. Lemmon) have each worked thirty-five miles with two-inch coils using a most pleasing high note. This was with a mechanical interrupter which is also a mechanical alternator.

It may not be as interesting to the autocrats with the 1 Kw. stations to have such an article, but there are more one inch spark coils in the United States, (Licensed and Unlicensed) than any other power. The following table I have recently compiled from the U. S. list of amateur stations. I feel sure it will be of interest to the amateur world to note that the average power of Licensed stations in America is only 259 watts. Note that the total power of amateur stations is 1,130 Kw.—if each had a range of 300 miles and they were placed at equal intervals around this earth of ours at the equator—the range would go around the world one and one half times!

Continued on Page 185

Transformation of Energy in a Condenser Due to Changes in Capacity

By R. H. Hough, Ph.D.

THE question of transformation of energy in a condenser due to changes in capacity is a rather fundamental notion which should be grasped by experimenters in wireless telegraphy. With the condenser as the most important piece of wireless apparatus, we can hardly afford to neglect any of its simple theory. It is hoped that this text will enable the readers to improve some of their knowledge as well as to correct any false notions.

First consider the electrophorus: a, is a non-conductor, say a hard-rubber disc; b, is a conductor, a metal disc supported by a non-conducting handle, C. All parts are connected to the earth by the hand or other conductor. The hard-rubber disc is electrified by rubbing with cat's fur. By convention, we assume the charge on the rubber disc to be negative. This condition may be shown diagrammatically by figure 1.

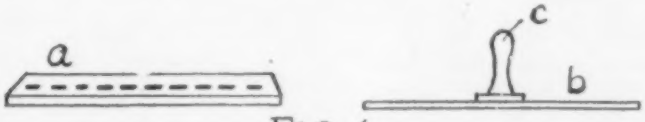


FIG. 1

If b is held very close to a by means of c, the lower surface of b is said to be positively charged and the upper surface negatively. These charges may be represented by Fig. 2. Now if the metal disc, b, is connected to earth, the negative charge is neutralized and the condition is represented by Fig. 3. The earth connection is now broken and the disc b is raised a short distance from a. Mechanical work is done against the electro-static force exerted by the attraction between the negative charge on a and the positive charge on b. The mechanical energy is turned into a higher

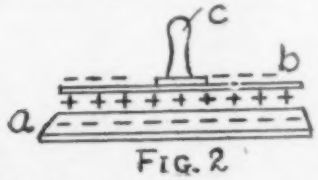


FIG. 2

electrical potential. The electrical potential energy of the system is increased and since the quantity of electricity remain unchanged, it is the work per unit charge that is increased by the separation of the oppositely charged plates. The work per unit

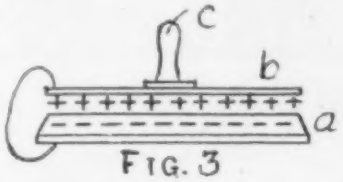


FIG. 3

charge is called the difference of potential. It is very small, approaching zero, when the plates are very close together, and connected to earth, but increases as the mechanical energy is converted into electrical potential energy by the separation. The electrical energy becomes sufficiently great to produce a spark discharge to the knuckle. The condition before charging may be represented by Fig. 4 and Fig. 1 shows the condition after discharge. Consider now what takes place as the uncharged plate, b, is brought very close to a. The positive charge on b is brought nearer to the negative charge on a than the negative charge on b; therefore, the potential energy of the system has been decreased. When b is connected to earth, a further diminution takes place. When the disc b is brought to the original position, the potential energy is increased and when the discharge occurs, it is reduced to the original condition, and the cycle of transformation is complete. It may be repeated at liberty.

If the disc b is hard rubber instead of metal and brought from 1 to 2, the upper and lower surfaces will be charged as represented. This process is called polarization. The electrical potential energy of the system is again decreased since the motion is in the direction of the resulting force. If the plate b (now hard rubber) is con-

Continued on Page 186

MONTHLY REPORT OF TRUNK LINES "C" AND "D"

A. A. Hebert, Manager.

As it was undoubtedly noted, no report appeared in the June number of "Q S T" from your Manager, which was not entirely his fault. The report was made and sent to the Editor, but a few days late—just too late to be printed, and apologies are hereby made to those members who were disappointed in not seeing anything pertaining to the two routes. Both reports are, therefore, consolidated.

Trunk Line "D"

It is with pleasure that I report the following arrangement of this Route:

(New York, N. Y.)
(Leonia, N. J.)
(Lakeview, N. J.)
(Nutley, N. J.)
Morristown, N. J.
Clinton, N. J.
Bethlehem, Pa.
Reading, Pa.
Harrisburg, Pa.
State College, Pa.
?
?
Pittsburgh, Pa.
Wheeling, W. Va.
Fairmont, W. Va.
Athens, Ohio.
Gallipolis, Ohio.
Portsmouth, Ohio.
Ironton, Ohio.
Huntington, W. Va.
Ashland, Ky.
?
Lexington, Ky.
Somerset, Ky.
?
Knoxville, Tenn.
?
?
?
Huntsville, Ala.
Birmingham, Ala.
Bessemer, Ala.
?
Montgomery, Ala.
?
?
Mobile, Ala.
?
?
Franklinton, La.
New Orleans, La.

A secondary route has also been worked out between Pittsburgh, Pa. and Lexington, Ky., as follows:

Pittsburgh, Pa.
Steubenville, Ohio.
Canal Dover, Ohio.
Cambridge, Ohio.
Newark, Ohio.
Columbus, Ohio.
Springfield, Ohio.
Dayton, Ohio.
Waynesfield, Ohio.
Hamilton, Ohio.
Cincinnati, Ohio.
(Newport, Ky.)
(Covington, Ky.)
(Bellevue, Ky.)
Ironton, Ohio.
Lexington, Ky.

This latter Route is a more round about way but should help during "QRN" The same plea is made as that appearing in the May number; that is, let your Manager know of any stations which can fill the gaps represented by question marks.

It has been a physical impossibility to write to every one of their appointment as Relay Trunk Line Stations, but fortunately the majority of the stations picked out, are already members of the League, and as soon as possible every one will be formally notified.

The Cities in brackets are close to each other and will act as relief if the work becomes too heavy.

Thanks are extended to Mr. Strausberger, Operator in charge of Pennsylvania State College Radio Station (8XE), Mr. Tallentire, of Bellevue, Ky. and Mr. Flehr of Ironton, Ohio, for their suggestions.

Trunk Line "C"

Through the good recommendations of Mr. Max Herzog, Secretary, Atlanta Radio Club, it looks favorable to the bridging of the gaps in Georgia, and probably a secondary Route will be worked out between Washington, D. C. and Savannah, Ga.

If the members in Washington and South thereof, will only come to my assistance,

with the names of stations they have worked with between Washington and Richmond and Portsmouth, better progress might be made. Thanks to Mr. Herndon, 3SZ, Portsmouth, Va. who gives me to understand that the A. & M. College at Raleigh, N. C. is installing a 1 k. w. set, which should be of great help to us on this line.

Everything indicates now that my report for the August number will give the Cities, calls and names of stations which have been appointed on Routes "C" and "D," and will place us in position by the 1st of September to begin earnest work in the relaying of our messages, and at the same time enable us to be of assistance to our Government if necessary.

Again I solicit suggestions from all interested in the proper working of these routes, and any one knowing of better routes than those already mentioned to reach the two farthest points south of the two trunk lines, should not hesitate to communicate with me.

In so far as Test Messages are concerned, it has been decided not to send these regularly until Fall, although it is my intention, to send a few messages to some of our stations South in order to discover where the worst breaks are.

Arthur A. Hebert,
246 Highfield Lane,
Nutley, N. J.

June 12th, 1916.

Pacific Coast Trunk Line Manager

EVERYBODY on the Pacific Coast and along the central Trunk Line from St. Louis to San Francisco, will be interested to know that Messrs. Howard C. and Lyndon F. Seefred, of 343 S. Fremont Ave., Los Angeles, Calif. have been appointed Temporary District Managers for Trunk Lines F and B, as shown on Page 21 of the February issue of QST.

Much difficulty has been experienced in securing a Manager to develop the Western Trunk Lines. It did not take very long to find Mr. Hebert and Mr. Mathews for the Chicago and New York Lines; but it has taken quite a time for the fellows on the Pacific Coast to indicate who they wanted. As a matter of fact, we had to write and telegraph considerably before we could get any one on the coast to suggest somebody. Finally one of our best friends gave us a lift, and the Messrs. Seefred have been appointed in consequence.

Their appointment is temporary, pending the results accomplished. If the development of the Trunk Lines F and B proceeds well, and the fellows in the west are satisfied, then we shall make the appointment permanent. This leaves it in such shape that we can meet the popular demand in case Messrs. Seefred for any reason are unable to handle the work of organizing and getting the Trunk Lines in shape.

For those who do not have at hand the layout of the original Trunk Lines, we are republishing in this issue the map. Attention should be given to this map by every amateur who considers himself able to handle any relay traffic. Any one not already occupying his place in the general scheme, should immediately write to the Manager of the Line on which he is located. For the benefit of those who are not posted, the following is given:—

TRUNK LINES C AND D.

Manager, A. A. Hebert, 246 Highfield Lane, Nutley, N. J. Call letters, 2ZH.

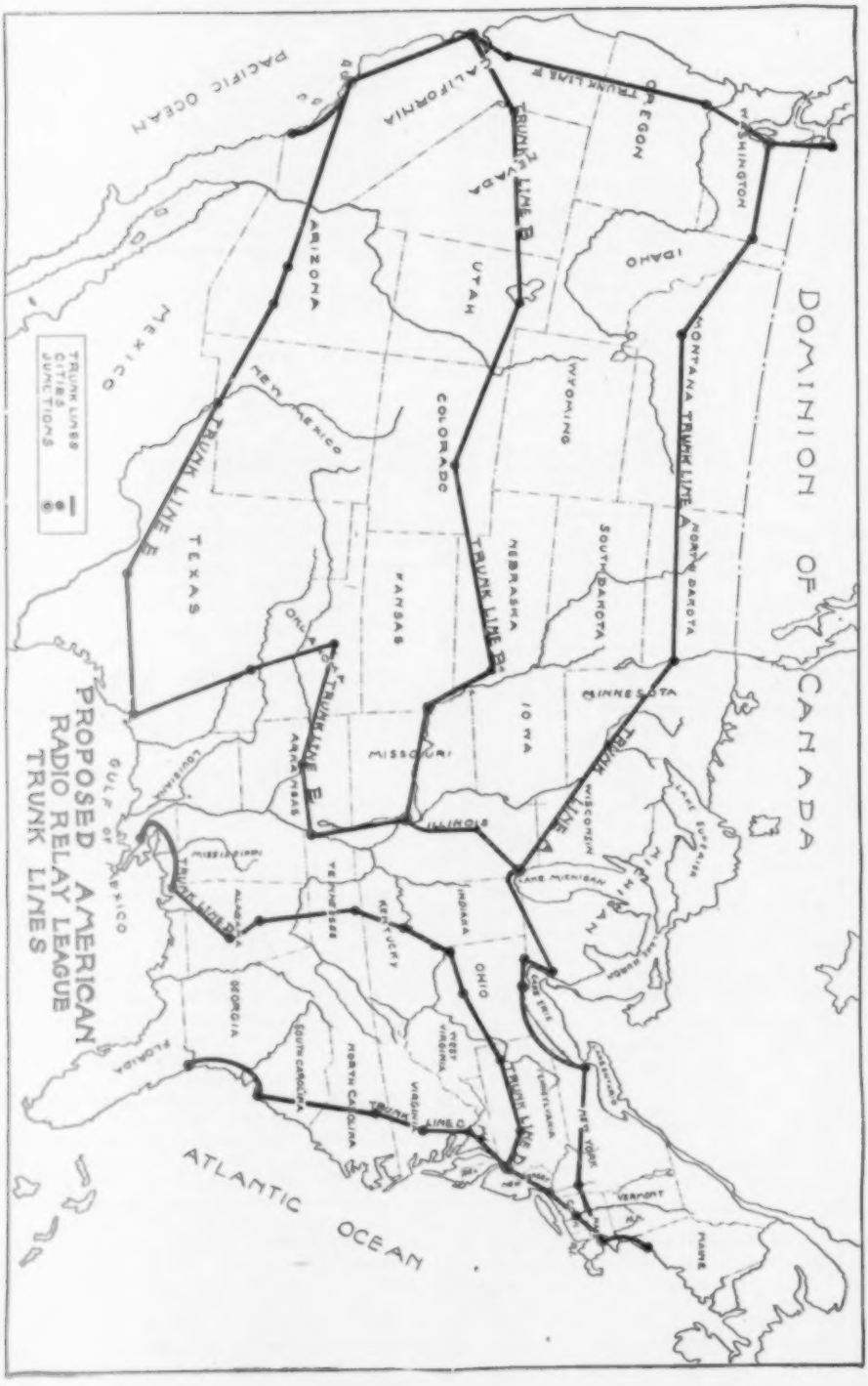
TRUNK LINES A AND E.

Manager, R. H. G. Mathews, 1316 Carmen Ave., Chicago, Ill. Call letters, 9IK.

TRUNK LINES B AND F.

Temporary Manager, H. C. and L. F. Seefred. 343 S. Fremont Ave., Los Angeles, Calif. Call letters, 6EA.

Each of the above is troubled with many open gaps in his Line. Let everybody who can help write to one of the above gentlemen and tell about his equipment and what he thinks he can do. Especially do we want to hear from the States of Virginia, North Carolina, South Carolina, Georgia, Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, Oklahoma, Texas, New Mexico, Arizona, Colorado, Utah, Nevada, Wyoming and Idaho. If you live in any one of these States, do not go to bed tonight without dropping a postal or a letter to your District Manager. If you live in some of the wirless States, but know someone in one of the backward States, don't go to bed until you have either dropped him a line or sent us his name and address, so that we can write to him.


PROPOSED AMERICAN
RADIO RELAY LEAGUE
TRUNK LINES
TRUNK LINES
CITIES
JUNCTIONS
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
MEXICO
DOMINION OF CANADA
CALIFORNIA
OREGON
WASHINGTON
IDAHO
NEVADA
UTAH
ARIZONA
COLORADO
WYOMING
MONTANA
NEW MEXICO
TEXAS
KANSAS
NEBRASKA
SOUTH DAKOTA
NORTH DAKOTA
OKLAHOMA
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
ILLINOIS
WISCONSIN
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
VERMONT
MAINE
TRUNK LINE A
TRUNK LINE B
TRUNK LINE C
TRUNK LINE D
TRUNK LINE E
TRUNK LINE F
MONTANA TRUNK LINE A

A Rotary Quenched Gap

Built and Designed by Roy C. Burr.

THE purpose of this article is to give the amateur a general idea of this rotary quenched gap together with some information as to its dimensions and construction. First, referring to illustration No. 1,

No. 1 Insulated fibre coupling made from two aluminum flanged collars, four 7/16" hard rubber posts and two strips of leather.

No. 2. Aluminum collar with fibre washer between it and No. 3.

No. 6. Fibre cover ½" thick fastened to No. 5 by twelve ¼" cap screws.

No. 7. Stationary binding posts.

No. 8. Twelve ¼" cap screws which fasten six to five.

No. 9. One of the two feet, drilled and tapped for 5/16" cap screw coming up through the base, No. 10 and 11, from bottom.

No. 10. Mahogany base which stands on rubber feet.

No. 11. Rubber cushions.

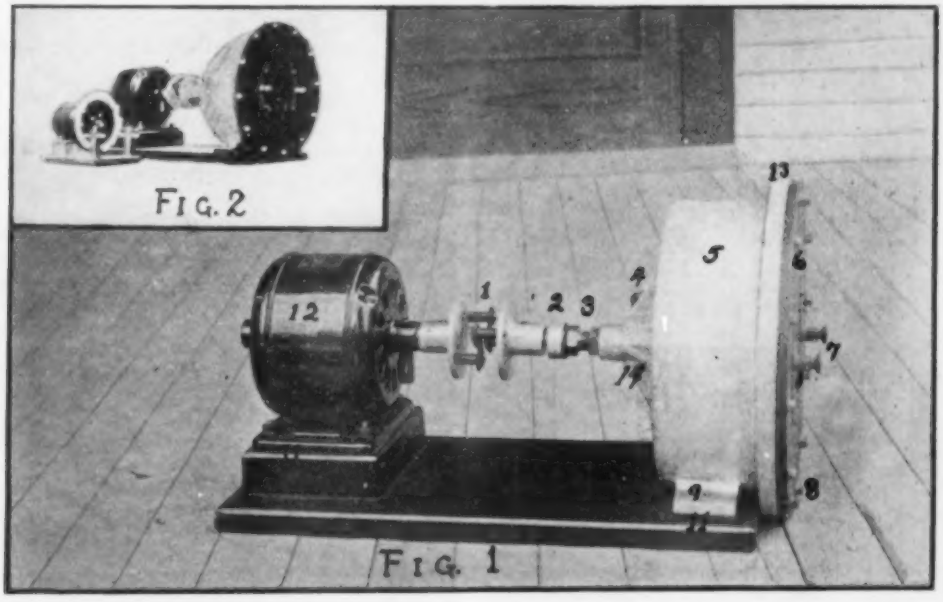


FIG. 1

No. 3. Screw bearing lock nut made from bronze hexagon rod with a half inch for shaft. Threaded on the outside. The inner end of No. 3 bears against the rotating disc on the inside of No. 5 and forms the adjustment of the gap. The leather in No. 1 gives the play for No. 3.

No. 4. Compression grease cup, feeds through ¼" pipe plug tapped hole. The thread on No. 3 being directly underneath with four small holes drilled through it to allow the grease to feed to bearing.

No. 5. Aluminum housing ¼" thick with exception of No. 13 where it is ½", Note webbing at 14 and feet at 9.

No. 12. Emerson induction motor, ⅛ H. P. speed 1750 R. P. M., wick feed oiler, ½" shaft. Stands 8" high; starts rotary in two seconds, and runs so quietly that one can receive without stopping it.

Inside of No. 5 and mounted on No. 6 are two aluminum half moon shaped pieces each of which carry six ⅜" aluminum points. Each of these pieces is electrically connected to No. 7. See Fig. 2, No. 7, where the two arc shaped pieces are bolted through to the moon shaped segments by ¼" brass screws.

On the inside of No. 5, revolving true and parallel with the inside base of No. 6 in an

aluminum disc 10" in diameter and carrying sixteen rotating points ⅝" thick and 1¼" long. The disc is made of aluminum and is ⅜" thick and has two brass hubs at the center, each 1½" long and 1¼" in diameter. The disc was perfectly balanced on knife edges.

This gap was designed for 2½ Kw. The housing No. 5 being 15" in diameter. If any of the readers should desire a smaller one for a 1 Kw. set, the dimensions can be cut down proportionately. One inch air space should be allowed for every 20,000 volts. That is, the inside of No. 5 at all points where there would be danger of short circuits should be allowed sufficient air space. On the rotating disc, 1¾" should be between points for every 20,000 volts of potential. If fewer points are used, a higher motor speed would be desirable.

The product of the motor speed and the number of points divided by 60 should be between 400 and 500. In the gap illustrated the frequency or number of sparks per second is 466. The tone received by distant stations is remarkably synchronous due to the constant speed of the induction motor. No. 3 is adjusted until the radiation shows greatest. Note the size of this gap in comparison with the ordinary Blitzen rotary shown in Fig 2.

Some First-Class Relay Work

A Few Suggestions.

By Mr. S. Kruse.

On the evening of February 17th, Henry Albach, Station 9QD at Lawrence, Kans., called 9DM, which was then working 9LO at Kansas City, and transmitted to him a msg. addressed to Mr. Leland Jenks of New York City. 9DM (Opr. "H. Z." Harry Ziesenis) at once called 9LO and gave him the msg. 9LO then asked 9DM to QRX and called 8NH at St. Marys, Ohio (Opr. Mrs. Candler) and transmitted the msg. In each case the message was repeated back correctly at the first transmission. From 8NH the msg. went to 2ZE (Leonia, N. J.) thence to 2BG and to 2AAK at 227 Audubon Ave., New York. (Opr. L. N. Cockaday.) As I understand it, this is only a few blocks from the destination of the msg. which was delivered to Mr. Jenks on the 19th, a delay having been encountered in locating the addresses at the time the msg. was received.

We have not been able to trace the reply to this msg. as it was unfortunately started over another route and accordingly hung up at 9LR in St. Louis. 9LR's signals are very erratic here, swinging very badly at all times. This seems to hold true for all stations in St. Louis, though they seem to have very little trouble in copying 9LO and 9DM.

As far as I know, all msgs. from Lawrence which have gotten through to the East have gone from 9DM or 9LO to 9FY or 9NN and then to 8YL, 8AEZ, or 8NH. At times, they have gone directly from 9DM to the Ohio station, while others at Special License stations have been cut in. The trouble with these Special License relays is that they seem to have no regular hours and no regular stand-by wave.

It seems as if summer work would require another station in St. Louis and one in Indiana. Possibly they exist, but we never hear them while the Ohio stations simply buzz in here. With an ordinary piece of Galena, it is possible to read 8NH, 8YL and 8AEZ on any respectable winter evening, while with the audion easily two dozen Ohio stations are readable. Incidentally, I admire the way the real good Ohio stations QRX whenever one of their number is doing distance work. It is not so here.

I wish to back Mr. Parks in his statement that low tones are at least as good as the high tones. Consider the stations just mentioned. Not one has a tone higher than 600 sparks while 8NH which easily drowns out any other station in Ohio, Illinois, Iowa, or Colorado, comes in here as a regular Marconi buzz. I understand that the note at close range is a mixed one, but the only part that gets here is a sound like that produced by a hornet's nest which has just been stirred up with a fish pole.

Furthermore, every station within Kansas and the adjacent states, that has ever accomplished consistent long distance work has done so on a low or medium note. The most popular gap in this neighborhood is a brass casting of five to seven inches in diameter mounted on a polishing head or a fibre disc on the motor shaft. The disc is most invariably milled to have 20 deep geer teeth and the motor is just as invariably one of the induction type. Whether belted or directly connected, these gaps are op-

erated at 1740 R. P. M. or near that speed with the result that a 600 spark note is produced. Doubtlessly, this gap would not appeal to those accustomed to the catalogue types that have a pretty little disc or a cross-arm mounted on a baby series motor, traveling at 500 R. P. M. or some such dizzy speed. I can assure these gentlemen that after they have once tried a well-balanced gear gap with a one inch face, operating at a sane speed by an induction fan motor and have learned that the whole thing is so quiet that it cannot be heard outside the operating room till the key is depressed turning out an absolutely clear crisp spark and is trouble proof (to the extent that even the most violent kick-back will not put the motor out of commission,) —they will change their minds.

The need of a gap which runs true cannot be overstated. I have seen stations in which the antenna current was double by no other change than simply balancing the rotary and setting the stationary electroes very close. In general, the gear gap gives best results when the spacing is as close as possible, which is less than 1/64" if the gap is properly balanced.

Before I "30" for the day, let me state a few notions as to my understanding of some signals and abbreviations. 9DM, 8AEZ, etc., are NOT PEOPLE. They are simply stations. The operator of 9DM is H. Z., the operator of 9LQ is L, and the operator at9XP is L. E. W. Any one of these operators is entitled to operate 9LQ which is nothing but a collection of wireless apparatus. The finish signal is not "AR," but simply our old Morse friend "F. N." thus, .—. —.

In the same way, the final closing signal is not "SK" as many seem to think. Again we have a wire line signal; namely, the Morse No. 30 that follows the last A P message of a day's press. The signal is not . . . —.— but . . .—. —

Well, CUL, FN 30 "L"

THE HIGH NOTE, LOW NOTE QUESTION.

John M. Clayton, Little Rock, Ark., sends the following communication:

I have read with interest the discussions on the advantages of the high—low note in amateur stations. I, personally, have never heard an amateur station with a high note that sounded anything at all like a commercial high tone. Of course, the commercials have a 500 cycle current. With the 60 cycle current of the amateur, the note loses all its good qualities when the gap is run too fast. I hear 5DU nicely on his low speed, but when he runs up higher the note loses all its good sound. 9UC comes in fine on his low note. I have a great deal better success in reading the low tones than those with the high, like 9XN. I like a note of about 240 cycles similar to the Marconi WRU, WST and WHK. I have tried receivers with different pitched diaphragms and still find the low tone easier to read. The only amateur with a high note whose tone is good is 8NH.

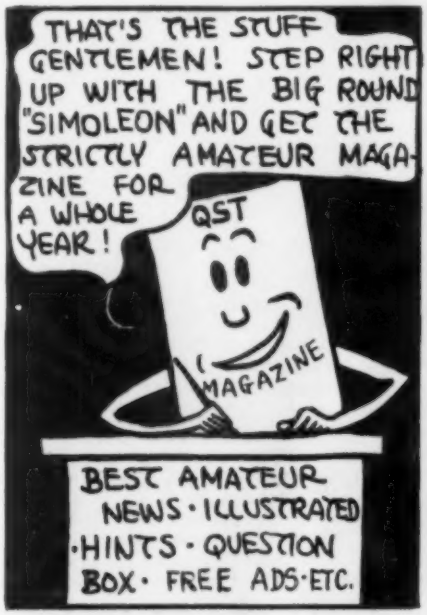
oo

SOME RELAY WORK.

Port Washington, L. I.

I sent a message in April for one of our high school teachers, a Miss Estelle Smith to her friends in Covert, Mich. The nearest place having an amateur station is Battle Creek, 8CX. Some time later Miss Smith received a letter from her people containing the message on one of the A. R. R. L. blanks in full just as it was sent. I gave the message directly to 9. C. The message records having been relayed via 8NH and 8CX. I write this merely to encourage our members to keep up the good work of confirming msgs.

I think QST has put it "all over" the entire field of wireless magazines for the amateur as it is entirely impersonal. All other radio papers seem to be selfish in themselves. QST has never given me that idea. (Sgd.) JACOB WEISS,


THAT'S THE STUFF GENTLEMEN! STEP RIGHT UP WITH THE BIG ROUND "SIMOLEON" AND GET THE STRICTLY AMATEUR MAGAZINE FOR A WHOLE YEAR!
QST
MAGAZINE
BEST AMATEUR NEWS · ILLUSTRATED · HINTS · QUESTION BOX · FREE ADS · ETC.

QST AND THE AMERICAN RADIO RELAY LEAGUE

A number of letters are published below which may prove interesting to the amateurs of the Country. Read them and draw your own conclusions. The whole story was brought about in this manner: The management of the League felt that a certain class of amateurs had never heard of QST or THE AMERICAN RADIO RELAY LEAGUE. Consideration of the matter seemed to indicate that the advertising circulation of The Electrical Experimenter might prove useful in this connection. We thereupon drew up an advertisement describing QST and sent it to the Electrical Experimenter. We then received the following letter from Mr. Hymes, their Advertising Manager:

New York, N. Y.
May 23, 1916

American Radio Relay League, Inc.,
Hartford, Conn.

Gentlemen:

Please accept our thanks for your order of May 20th for a three time insertion of your advertisement which we regret we cannot insert as your advertising is distinctly competitive to The Electrical Experimenter.

Regretting that we are unable to be of service to you, we are,

Yours very respectfully,

The Experimenter Publishing Co., Inc.

(Sgd.) Milton Hymes, Adv. Mgr.

This letter was replied to as follows:

Hartford, Conn.,
May 24, 1916

The Experimenter Publishing Co., Inc.,
233 Fulton St.,
New York, N. Y.

Attention Mr. Milton Hymes.

Dear Sir:

Replying to your letter of the 23rd, we wish to suggest that you re-consider the idea of competitiveness between QST and the Electrical Experimenter. The AMERICAN RADIO RELAY LEAGUE and QST are operating organizations. QST is devoted to the actual operating conditions. We regard the Electrical Experimenter as a companion magazine; a magazine of an entirely different type. Your paper is devoted to articles which would interest an experimenter and one who wished to keep abreast of the electrical news. Our paper is to keep each amateur in touch with the other regarding the operations of their stations.

We feel that the magazines are being developed along entirely different lines and are companion papers. One is not completely satisfied with one and not the other. This means that the more QST's are sold, the greater will be the demand for the Electrical Experimenter.

The idea of competitiveness seems farfetched and we trust that you will re-consider the subject and favor us with an im-

mediate reply.

Cordially yours,

THE AMERICAN RADIO RELAY LEAGUE, INC.

(Sgd.) C. D. Tuska, Secy.

The Electrical Experimenter replied to this as follows:

New York, N. Y.
May 27, 1916.

The American Radio Relay League, Inc.,
Hartford, Conn.

Gentlemen:

In our letter of the 23rd, the word, "competitiveness" is really the wrong word. The idea we wish to convey is, that insofar as there is in existence today the Radio League of America, which we believe covers all the functions of your organization, it would simply be causing the interest of the amateur to be divided up through carrying your advertising. It is therefore in the interest of all amateur art that we find it necessary to decline your advertising.

Assuring you of our appreciation of your order, and anticipating that we may be of service to you in the future, we are,

Yours very respectfully,

The Experimenter Publishing Co., Inc.,

(Sgd) Milton Hymes, Adv. Mgr.

This did not quite meet with our views, so we wrote again as follows:

Hartford, Conn.,
May 29, 1916.

The Electrical Experimenter,
233 Fulton St.,
New York, N. Y.

Attention: Mr. Hymes.

Dear Sir:

We thank you for your prompt response to our letter of recent date and would like to trouble you once more. Since in yours of the 27th inst., you agree that it is not really "competitiveness" on the part of the magazines, but similarity on the part of the Radio League of America and THE AMERICAN RADIO RELAY LEAGUE, that forces you to decline our advertising, we wish to suggest that you give this point more consideration before you refuse our advertising.

We wish to be very clear in stating that THE AMERICAN RADIO RELAY LEAGUE is an organization devoted to the actual relaying of messages,—not in theory but in actual practice. We understood that the Radio League of America was a purely scientific organization and we fail to see how their interests on these lines can possibly conflict. Will you not kindly inform us if these ideas are correct?

Trusting that this will clear up all signs of confliction and that the advertising will be accepted, we are,

Very truly yours,

THE AMERICAN RADIO RELAY LEAGUE, INC.

(Sgd.) C. D. Tuska, Secy.

Evidently, the Electrical Experimenter did not wish to commit themselves on this point for their reply was as follows:

New York, N. Y.

Mr. Clarence D. Tuska,

c/o The Amer. Radio Relay League,

Hartford, Conn.

Dear Sir:

Replying to yours of recent date, we still cannot see our way clear to changing our decision in regard to accepting the advertising of THE AMERICAN RADIO RELAY LEAGUE in our magazine, and we are therefore, returning under separate cover the cut left by your engraver.

Yours very respectfully,

Experimenter Publishing Co., Inc.,

(Sgd.) Milton Hymes, Adv. Mgr.

This correspondence will not be commented upon. We leave judgment entirely to the amateur wireless station owners of the Country. We merely point out the facts regarding the AMERICAN RADIO RELAY LEAGUE, which are that we amateurs of the Country organized it early in the Spring of 1914, and named it THE AMERICAN RADIO RELAY LEAGUE. There was no other League of wireless operators in existence at that time. We offered nothing for sale, and gave no pins or penants. After we had issued our call book, and were well organized and conducting actual relaying, we noticed the advent of the Electrical Experimenter's League which was given the name of The Radio League of America. We did a lot of thinking when we noticed the similarity of the name, and we have done a lot more since. Far be it from us to knock any other organization. We simply want the amateurs of the Country to know the facts.

Undamped Waves

The amateur is certainly showing his color when he so soon begins making use of undamped waves. It is a sign of the times because Sayville himself was using the ordinary spark only a few months ago.

It reminds us of a discussion we took part in recently, with one of the Government District Radio Inspectors. The latter was commenting upon the tremendous improvement in knowledge on the part of the amateur. This year, it is the rule that the amateur gets better than 85% out of a possible 95%, on an examination for First Grade Commercial License. Three years ago, it was unusual for the average amateur to secure 75%. It seems that the full 95% would often times be the mark obtained today, but for the little technicalities which indicate carelessness rather than lack of knowledge of the subject.

We asked this Inspector where he thought the amateur equipment would be five years hence. He said he had not the least doubt that every good amateur would be transmitting by means of undamped oscillations and that he would consider it absolutely necessary to be able to hear all the high power arc stations in the world, five years from now. This nearly caused us to reel off our chair when we first heard it, but a little thought made it look quite reasonable. The average amateur equipment among the better stations is today more sensitive than the average commercial station. This, together with the influx of mature men into the game, have brought about a general readiness to spend money on equipment. Where $50 on a piece of apparatus seemed beyond the limit three years ago, $250 is now choked down with not much gagging. Some amateur is to be the forerunner of a lot of undamped wave work, and we are waiting for it. Nothing will help us perfect a country-wide relay system so quickly. Welcome, Mr. Undamped Wave and watch us amateurs lick you into shape for overland transmission. We will find a way to operate you with apparatus of moderate cost.

Somebody says, "Why not give special appointments to stations which will equip to handle undamped waves?" It certainly opens up a new line. Our District Managers will probably think long and seriously about this question, because it is they whom we depend upon to bridge the long gaps. Undamped waves would certainly help do this especially when it comes to local interference.

If it turns out that transmitting apparatus can be developed for transmitting undamped waves, and which will be of moderate price, it might be that there would be something in this idea of creating a higher class certificate for undamped wave stations. They certainly would be entitled to it. They would become what would amount to the old Star Stations. We could count upon them for the long distance work. This is one of the things which we must all bear in mind as time goes on, and the undamped wave comes into more general use.

QRK

We did not realize what a momentous occasion it was when the President walked into the closet which we call our office, and shot that one at us about suspending publication during the summer months. We printed something about this last month, and the way it did things all over the country, has surprised us.

If we had the time or the necessary clerical help, we would make a count of the letters we have received urging us to keep on during the summer months. But, we have neither, so we are compelled to let it go at "a large number." Large is what it is all right, as we can see from here at the typewriter, because the job of filing them will take plenty of patience, prespiration and profanity..

Many of the letters were especially helpful since they contained the real stuff that makes things go, namely the coin. This has helped our circulation very considerably, which always imparts sand in our craw, and stiffness to our backbone. If it keeps up, it will settle the question the President asked, and much to the satisfaction of all hands. While it might cause the loss of an exceptionally literary waiter at some popular summer resort, it will ensure a job for the printer and probably cause a certain rotary gap to be dismantled and fitted with a fan. This commodious closet of ours, while quite efficient in lack of disturbing influence, certainly knows how to get hot in the summer time, and cold in the winter, all of which amounts to saying that we much appreciate the flood of congratulations from friends and that we shall certainly be able and glad to get out a July and an August issue if the response to our appeals continues.

We taper off this eloquent effort with an appeal to all concerned to "do their bit" and remember that we are a mutual organization of wiresless bugs and that we are dependent upon every fellow doing his share,

To make "QST" the magazine which you want and need, we must have a large number of pictures of wireless stations. These illustrations bring suggestions and ideas to you. In a picture you may see a better way to arrange your set, a shorter-lead connection, a new oscillation transformer, an ideal condenser. All these things help to improve your set, increase your range, and develop your ability as a Relay Station. If you have a photograph, send it in today. This will help you and your fellow amateurs. If you can write a short description, do that too. Don't think your set is not as good as the other fellows. QST, QST, QST, QRU? QRU? QST?

A Radio Station at Lewiston, Montana

Description of A. C. Campbell's Apparatus.

Practically all the apparatus shown is home-made. The tuning transformers are interchangeable and of three different sizes. The double audion is used for spark stations while the tubular bulb is in operation for continuous waves. Loading coils under the table build the tuning range up from 200 to 12,000 meters.

The sending transformer is on the other side of the wall with lead wires going to condenser case which contains the primary and antenna condensers. The antenna used is 200 feet long and 100 feet high. As show in the photograph, it is quite clear of all surrounding objects. A number of the most distant amateurs copied and worked are 5BJ, (Dallas, Tex), 8YL, (Lima,

Ohio) and 7ZH, 6ZV, 9YG, 9XU. Press is copied from the following stations, mountain time,

Arlington, 2500 meters, spark, 6:30 P. M.

Lepass, Manitoba, VBM, 2,000 meters, 1:00 P. M. and 5:30 P. M.

Miami, WST, 500 meters, 10:00 P. M.

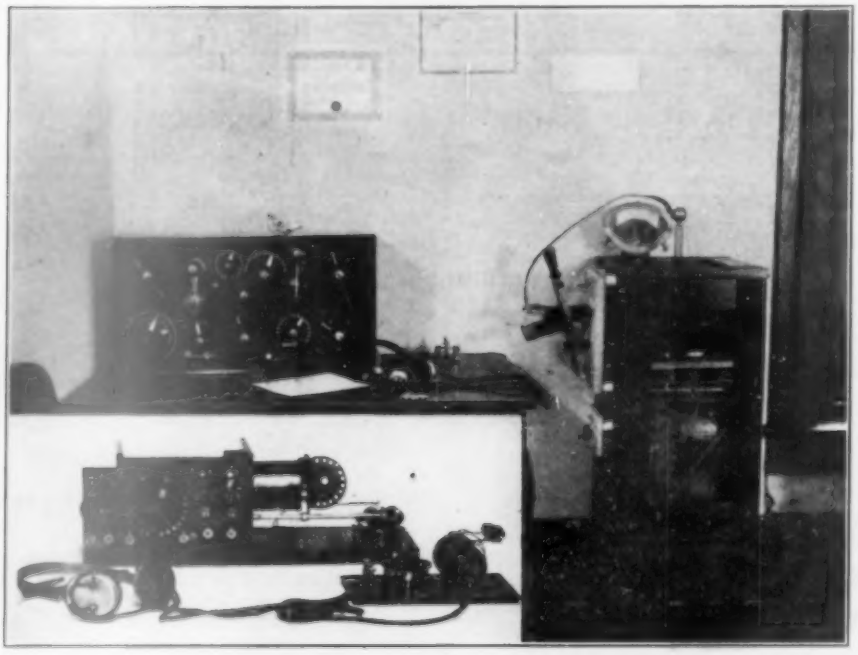
San Francisco, KPH, 500 meters, 2:15 A. M.

South San Francisco, KSS, continuous wave, 1200 meters.

Sayville, 8,000 to 9,000 meters is heard at certain intervals. NAA, time and weather reports are copied at 10:00 A. M. and 8:00 P. M. Grand Forks, 9XN, is heard at 11:00 A. M. and 4:00 P. M. on 1500 meters. Denver, KIX, 600 meters, at 10:00 P. M., Mare Island, NPG, at 1:00 P. M. and 11:00 P. M. Wireless telephone tests have been heard at different times in the evening between Portland, Ore. (KFU) and San Francisco, (KFS) on about 4,000 meters. (This schedule will prove valuable and interesting to amateurs of the Pacific Coast.

—Editor)

5AX, Shreveport, La.



The accompanying photograph shows a station which has been receiving amateurs of the Eighth and Ninth Districts. This apparatus also figured in the relay of February 22nd. Mr. D. R. Simmons, the owner, says that the approximate receiving range from amateur stations is 1,000 miles. The antenna is only 20 feet high and 100 feet long. With the exception of audion, phones and aerial switch, the set is home-made.

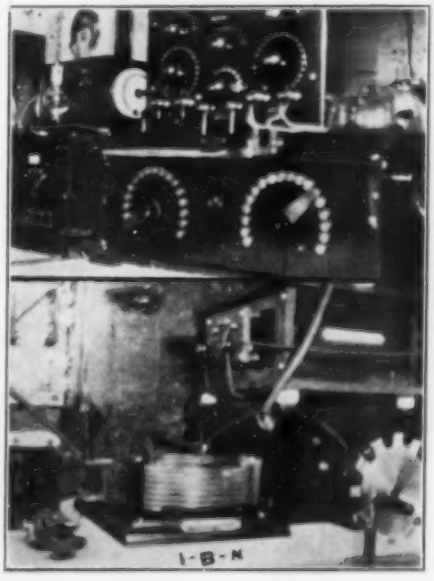
The insert shows a complete radio set which is used as an auxiliary equipment. This receiving outfit comprises a special loose coupler, variable condenser, and detector of the crystaloi type mounted on springs with a de-cohering inductance. A buzzer is mounted on the tuner base. The apparatus is capable of tuning to 3,000 meters.

A Central American Station

We are publishing a photograph of Eugene Howell of La Ceiba, Hond., C. A. His station is located far away where we believe amateur interference is reduced to a minimum. Mr. Howell copies press news from WST, NAR, and WNU. He is able to furnish nearly all the war news to the town of La Ceiba.

The apparatus consists of a Blitzen type D tuner; variable condenser; fixed condenser; Holtzer-Cabot, 3000 ohm phones, and mineral detectors. The antenna is composed of two wires, 50 feet high, and 275 feet long.

One of the Vermont Relay Stations

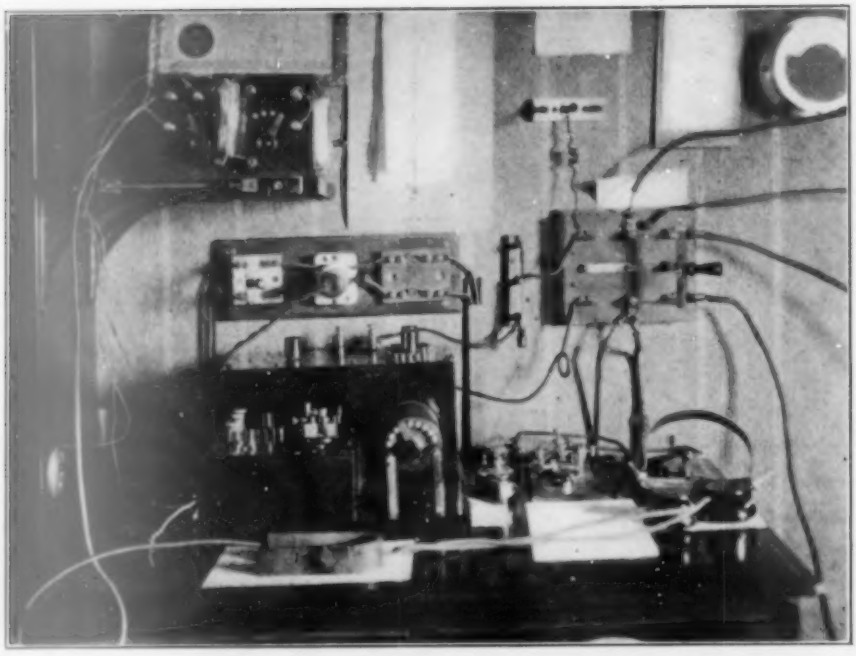


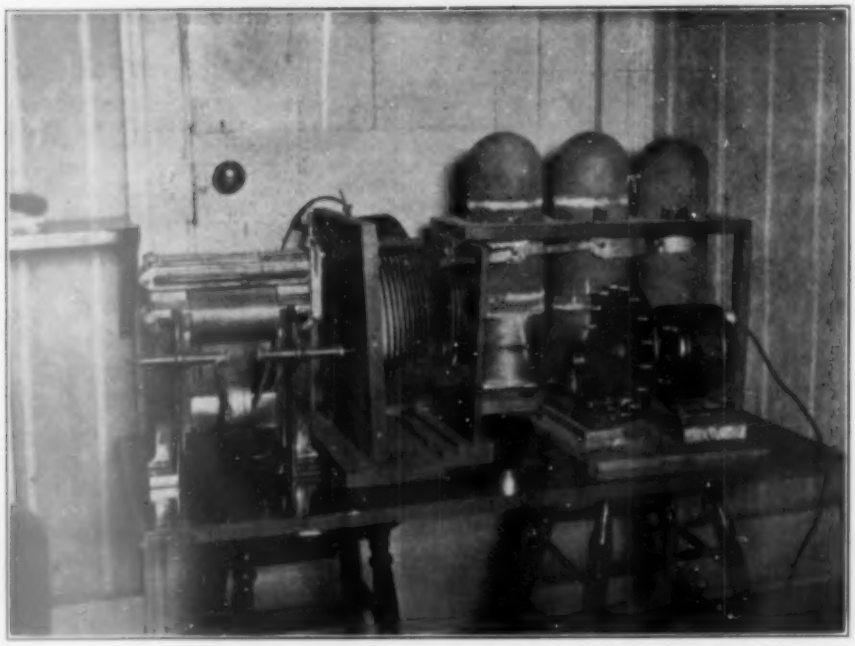
The illustrations show the apparatus owned by Raymond H. Shaw of Rutland, Vt. He is using an audion for amplifying the signals of a silicon detector. The cabinet is a Mignon, type L-C-2, special. 10,000 meters range. Mr. Shaw says "It works to perfection on the longer waves, but has too much capacity for the amateurs." Directly beneath the audion is a cabinet type 1500 meter range, loose coupler set for the shorter waves. The silicon detector is under the glass dome at the right of the Mignon cabinet. Brandes 3200 ohm phones are used.

The second picture shows the sending set. It consists of a half Kw. Packard transformer in a case of original design, glass plate condenser, non- synchronous gap and a Murdock oscillation transformer.

"This is a new set so I do not know the range as yet. Have been heard 40 miles from here. If anybody heard 1BN, Q-S-T-ing, please let me know by mail." R. H. Shaw, 110 East Washington Street, Rutland, Vermont.

Radio Station 8JZ



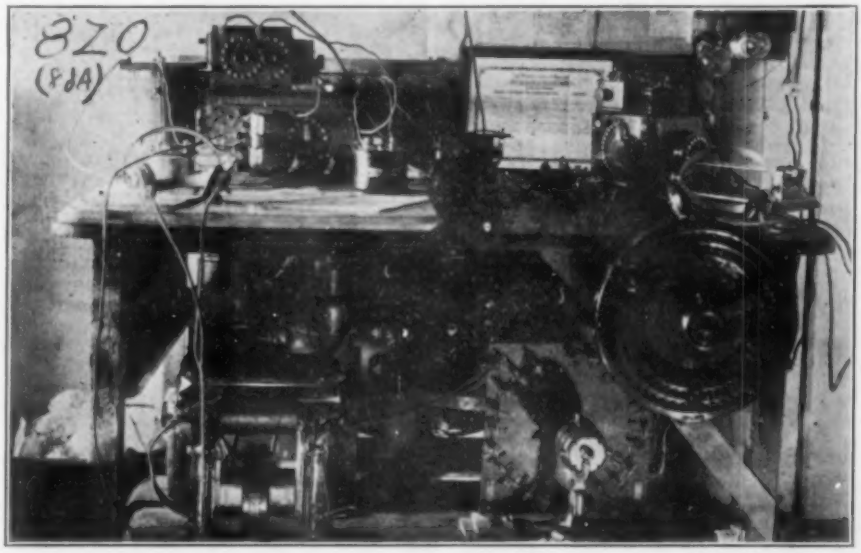


RADIO STATION 8JZ.

Many of our readers have heard the call, 8JZ, and doubtless wonder about the apparatus which Mr. A. J. Manning of Cleveland, Ohio, the owner, uses. Mr. Manning has found it necessary to assemble the sending apparatus for the picture. The most striking feature is the condenser. It is of Marconi type and it must be efficient to get the remarkable results which we all know Mr. Manning has gained. The rotary is also a little different from the ordinary type which one buys. The studs are much smaller and there are more of them. This leads us to believe that the motor is run slower. This is a desirable feature since it starts up faster and slows down quicker than one of the "race me" series type.

The receiving apparatus is the regular loose coupler and audion set found in so many amateur stations. Mr. Manning has explained in detail his set in an article on Page 143 of the June QST.

A Five Hundred Mile Set



We are publishing the latest illustration of radio station 8ZO. Mr. R. Gunn of Oberlin, Ohio, says "I have to make my own 'juice' so I can't answer everyone that calls because I have to beat down in the cellar in order to get 'juice' (hi)." The picture is self-explanatory with the exception of oscillation transformer which does not show up very well. The primary is three turns of one inch brass ribbon with two ribbons in parallel and paper between them. The secondary is of No. 10 lamp cord, carefully insulated with Empire tape. There are fourteen turns on the secondary and it is arranged so I can swing it and change coupling even while sending. This enables me to emit a broad wave for calling and a sharp one for working. The reostat controls the voltage and cuts out the generator exciter. The normal radiation on one kilowatt is five to five and one-half amperes.

Stations have been worked in every district but the sixth and seventh. Mr. Gunn tells us that he is a "Son of a Gun" and has very little time to do a great deal of relay work. He has only handled about seventy-five messages during the past season.

Radio Communications by the Amateurs

OUR LEAGUE

Mr. John H. Barrett, of Greenwich, Conn., has been a member of the American Radio Relay League from its earliest beginning. The Editorial in the June QST brought these remarks from him:

The A. R. R. L. has done good work. I appreciate QST and I figure that all good, live, members do the same. After reading your last issue, I had the blues because I supposed that the organization was coming along in good shape. The trouble is that some of our younger members seem to think an institution which offers them a three cent badge and a flag to hang from their aerial mast, that will fade out in the hot sun in less than two weeks' time, and a stereotyped signature of one of our great wireless men, that looks as much like his signature to one who knows, as a ground-switch does to a ground hog, is the real thing. One must also send in the price of a years subscription to some wireless magazine. I have been in the wireless business for the past seven years. I have never as yet had a picture taken or published of my station because I think it is only for the minute. I have all the law allows and do as good work as any. From the beginning I have been much interested and encouraged in the work that OUR A. R. R. L. has done and will do after some of these so-called mushrooms die out. I have instructed many scholars; installed stations; seen them do good work, and done all in my power to help them along. While I have not been as active in relay work as some of our members, I have been content to sit by and listen in, and appreciate the good work that has been carried on by our good officers.

Our members must bear in mind that this has been done without compensation to them. If the organization is in need of funds to carry on this good work, I can see no reason why the Officers should be called on to dig down for money to carry on the work which up to this point has advanced so rapidly. I am sure that every wireless club throughout the U. S. should request that each and every member of its club be a subscriber to QST. The time will come when we shall need an association of this kind to look out for the amateur. With a strong organization of this order showing the Government what we can do, we will stand a better chance of getting our rights than though we were depending upon a publication that has no further interest in us than to get our yearly subscription so that their circulation is built up and the advertising comes in. And speaking of advertising, each and every member of this association knows that there are no goods advertised in QST but that they have been tried and found to be just as they are represented. Anything you buy through the advertisements of QST are as guaranteed or money back. How many beginners have been stung by full-page displays in other periodicals and only have to discard what they bought, and begin all over again? How many of you can afford that? This, in itself, should be an inducement to all honest, reliable manufacturers of wireless goods to advertise in QST.

I can see no good reason why the management of QST should not call upon its members for voluntary contributions to carry on this good work and I am sure it would meet with a hearty response. I, myself, while not over-burdened with this wealth have five or ten dollars which I would willingly contribute to the cause,—To keep our pet and pioneer association before the amateur. Let us hear from some of the rest.

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We want to thank Mr. Barrett as well as several others who have come forward with voluntary subscriptions to assist the League work. Mr. Barrett hoped his remittance would do more than give five dollars to help pay expenses; he wanted it to be the fore-runner which will awake our spirits with the idea of 'sharing our bit of our League's finances.' We are printing

below a list of contributors up-to-date, and in the August number we shall continue the Roll of Honor with the names of those who adopt Mr. Barrett's suggestion:

LEAGUE HELPERS

Radio Club of Hartford	$50.00
H. P. Maxim	75.00
C. R. R., Jr.	25.00
S. Delbert	10.00
J. Barrett	5.00
Mr. Seabury	2.00
G. Chutter	1.00

oo

ONE OF OUR MEMBERS

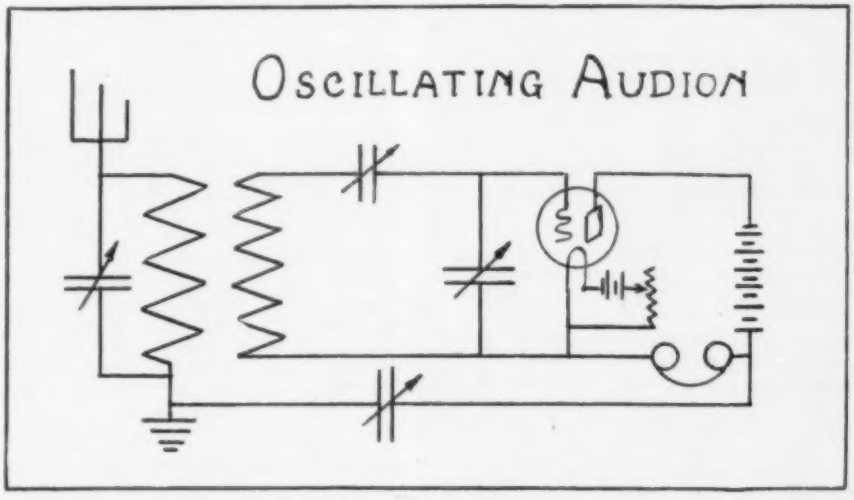
H. Clifford Hunter of Wayne, Pa. informs us that he has been compelled to forego operating his wireless station for some time and that it would be advisable for us to count him out of active relay work for the present. Mr. Hunter expects to get in the work in the not very distant future.

oo

ANOTHER HOOK-UP FOR THE OSCILLATING AUDION

By Lindley Winser, One of the Western Correspondents.

The accompanying diagram shows a connection for the tubular type bulb which has given fine results in my case. I have no data as to how the globe type bulb behaves with this connection but I can see no reason why it should not work as well.



Awakened by QST

By D. A. Hoffman

The variable condensers are all of moderate size; a maximum capacity of .001 mfd. is ample for all if a fairly fine adjustment of the coupling inductances is provided by numerous taps.

No inductance coils are used with the exception of the loose coupler which is of common design, but large size. The coils are 12" long wound with No. 32 wire, the primary being six inches in diameter and the secondary, five.

Using an antenna 100 feet high at one end and 45 at the other, 80 feet long, no trouble is had in copying NBA, Darien, Panama, and the arc sets at NAA, NAR, NAT, NAJ, also WGG, and WSL, at night. The Federal Telegraph Company's big arc station in the Hawaiian Islands can be read at any time, day or night, except through bad static. These results are obtained at a station surrounded on three sides by high mountains from 20 to 40 miles distant. The country around the station is the driest in Central California, rainfall from 6 to 10 inches a year.

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A COMMERCIAL'S OPINION.

U. S. Coast Guard,
Cutter Tallapoosa,
Mobile, Ala.

Editor QST,

I bought a QST the other day out of curiosity and wish to say that I find your paper most unique and useful in the field that others have tried to cover properly, but never quite succeeded. I know that QST is a long-wished for publication.

I noticed an article by "The O'd Man" on "Rotten Sending," which as far as I know is a pioneer of its kind and one that should make most operators think several times before 'slamming it out.' I am a "Profesh," at least I think I have the right to call myself by that name having been pounding brass on the Radio since it was first a commercial success. During that time, I have had plenty of opportunity for observation as to the different styles of sending. I find they vary like womens' hats. The originators of the Morse and American Morse codes would never recognize their own characters if they could hear not only the amateurs but also a goodly number of the commercial operators sending stuff that takes a mighty good op' to copy.

From the very first, I adopted a style of sending that I have found to be the best, namely, about eighteen words per minute with all letters made very carefully and swung together to sound rythmical. I can truthfully say that I have NEVER been called upon to repeat on account of "bum stuff." This scheme in the long run will enable a man to cover more ground and assist in saving the nerves and temper of the receiving operator should they ever come into commercial work.

I think that you are doing a mighty fine thing to impress your operators with the necessity of cutting out that spasmodic, flighty, and senseless style of sending and buckle down to the good old stuff that anyone can read.

Hoping you keep up the good work and wishing you success with your paper, I beg to remain,

Truly yours,
(Signed) H. L. BROWNLIE,
Chief Electrician, Radio, U. S. C. G.

oo

LEAGUES, LEAGUES, LEAGUES.

By Chas. A. Stanley.

Considering the unreasonable lack of judgment on the part of numerous amateurs throughout the Country, relative to the organization of radio relay leagues, I submit the following to QST:

I have of late received numerous invitations to join new relay leagues. The invitations read: Send us twenty-five cents, and so much more each month, and you will receive membership certificate and certain other considerations such as, the opportunity to obtain apparatus at ten per cent. discount, etc.

I am strong for progress and advancement of Our Relay work, but I know that success in any line cannot be attained by accepting every suggestion made, but rather by selecting the best possible avenue to success and then bending every ounce of energy through that avenue. The successful business man does not accept and make use of every new idea presented. NEVER. He lays out, in his mind, and then on paper, a clean-cut road at the end of which he sees in glaring letters SUCCESS. He then spends money and energy along that line and finally reaches the goal.

EFFICIENCY. Let that word sink deep into your mental system. Efficiency is the word which has accomplished so much for the great systems of our Country. Why not use efficiency in Our Radio Relay work? Accept the BEST; then work like "sixty" toward the goal SUCCESS.

Listen, Fellows, use a little good judgment. We have the AMERICAN RADIO RELAY LEAGUE which was organized at a great

expenditure of money and energy. It is without question the VERY BEST road to success in relay work. Why not spend your energy along this already well-defined line? All pull together and make a howling success.

I am not condemning the state and city radio clubs or any of the organizations which tend to promote radio interest. I do most emphatically condemn the organization of new radio leagues when we have so efficient an association as THE AMERICAN RADIO RELAY LEAGUE.

In thinking over this subject, I have come to this conclusion: The Amateur who seeks to promote a new relay league is prompted to do so by one or both of two motives. First he hopes to relieve the younger amateurs of a little coin and thereby fatten his own pocketbook. Second, he expects to obtain publicity which will place his name in the Hall of Fame as a Radio man. Believe me, there is not one HONEST cent (note the honest) to be made in an organizatjon of this kind. If you are looking for an opportunity to make good as a radio man, just write your ideas to THE AMERICAN RADIO RELAY LEAGUE and you will find the Officers waiting with open arms to accept you as a promoter of work in your section, providing your ideas are good and the Officers can see in you a man of ability.

Listen again, Fellows, CUT this "side-show" business and get into a field of usefullness by uniting your efforts with the work which has accomplished wonderful results.

OO

RELAY WORK IN THE SUMMER.

One of our members, Mr. Alvin C. Spencer, of Magnolia, Ill., sends the following letter on the question of discontinuing the relay work during the summer:

"A few days ago, I received a letter from Mr. Mathews, the District Manager, saying that after May 20th all relay work would be discontinued until next winter."

I think this is a very big mistake. If we were in war with some nation, do you think the war would be stopped on account of static disturbances? We all know it would not. Now do you think that just because we have encountered an obstacle we should stop work and not hold ourselves in readiness to help our beloved Nation? It looks to me that if relay work should stop now it would disclose a weakness in our League that might be the downfall of it. It will prove that we do not have 'backbone' enough to work under strained conditions. If we cannot work through bad static, how could we work with war on us?

I am sure that we all want the League to progress and progress rapidly, and that we are all the more willing to sacrifice a little time and money for the cause. I would suggest that relay stations be placed closer together daytime. With this arrangement, relay messages could be handled without the least chance of mistake or failure. For instance, work might be started on certain afternoons at four o'clock. At this hour messages could be handled before the Demon Static starts 'his press stuff' for Mars. I hope this matter will be considered in the same light that it is sent and that it will be taken as a co-worker's suggestion rather than an unfriendly dictation."

In reply to this communication, the District Manager says:

"We might let those stations which will operate during the summer work among themselves, but so far as I know, Mr. Spencer is the only man on route E outside of Dallas, Texas, and Chicago, who will be on during the next three months. It is all very well to speak of overcoming obstacles, but there are some which one cannot surmount. The following account may give one an idea as to the question of relay work during the summer in my territory. 9XN and 9YG, being Colleges, are closed in the summer. 9 BD writes that in the summer he can draw one foot sparks at the rate of ten per minute from his aerial. I am afraid that even the need of our Country could not overcome that kind of static. 9BD says that he is unable to hear the commercial station in Chicago, radiating 15 amperes and he never hears an amateur in the summer. There is the nucleus of Route A going West.

8NH and I are no longer able to hear each other while we were able to read each others's signals in the winter with the phones five feet from the head. We have been trying to locate some station midway between us, but have been unsuccessful. 8JX, 8JZ, 9NN, 9JT, 9GY, 9BD, and 8NH have all written asking me to discontinue summer work. This was long before I ever thought of doing it. It appears that Mr. Spencer is in a minority.

As you undoubtedly know, to be successful at all, an undertaking must be a success at the start, and cannot be allowed to drag along. We were unfortunate in the time of year when this relay test started. My idea is to postpone the real start until Fall and then make a start the momentum of which will carry us through the follow-

Continued on Page 186

This new department has been opened up for the benefit of the readers of "QST", Letters should be addressed, "QST", care of The American Radio Relay League. The Queries Department, Hartford, Conn. The questions will be answered free of charge and as promptly as possible. The answers will in each case, appear in "QST", provided however, they are of interest to the average reader. We are not in a position to answer questions requiring a long, mathematical solution.

The Editor hopes to receive a large number of interesting questions for the next issue. He trusts that you will make your questions of general interest and will refrain from asking questions which you can answer by consulting the Radio Laws and the Call Letter Books. "QST" does not wish to pad this department out with a series of uninteresting, foolish, questions.

W. Macke, Franklinton, La.

Ques. 1. Will an aerial supported in a tree 65' high at one end and by a pole 45' high at the other, be affected by trees in the immediate vicinity? They are within 100' and on two sides.

Ans. 1. The height of the trees compared with the height of the aerial is an important factor in the amount of energy which the trees will absorb. These trees, no matter what their height, will have some effect on your sending and receiving. This will be more noticeable in the summer when the leaves are out. However, you will probably not be troubled seriously if the trees are not very high.

Ques. 2. It is impossible to get a good earth connection, due to the height of the ground and the dryness. How can I improve the ground which I am now using? It consists of a number of copper wires buried to a depth of one foot, extending in different directions.

Ans. 2. One of our correspondents informs us that he got an excellent earth connection by putting several copper wires eight inches under the earth, directly beneath his aerial and parallel to it. He tells us that with this arrangement he gets better radiation and has not trouble from kickbacks and the like. He has also driven three one-inch iron pipes four or five feet long, and all the ground connections are made with wire not smaller than No. 8.

Ques. 3. Will an aerial 60' long and 45' high with a 32' lead be very efficient for a 200 meter sending set? Also what is the wave length of the same, the ground lead being about 5' long?

Ans. 3. This aerial will prove very efficient on a 200 meter wave since its natural period is about 180 meters and this allows for a suitable amount of inductance.

OO

E. Donovan, New Rochelle, N. Y.

Ques. 1. How many sections of Murdock moulded condenser should be used in connection with one of the old United Wireless type transformers, having a 20,000 volt secondary?

Ans. 1. Since the capacity of one section of Murdock moulded condenser of the amateur type is .0017 and the capacity for a 200 meter wave with one turn of inductance, 8½" in diameter, is about .01 mfd. you can only use six sections. However, the strain on six sections would probably be too great and it would be advisable to use twenty-four sections in series parallel.

Ques. 2. Is it advisable to use this type of condenser and if so, what hook-up should be used?

Ans. 2. This type of condenser has proved very efficient with exceedingly small losses and would be advisable to use. If you do not wish to risk the strain on six

sections in parallel, you should connect two sets of twelve in parallel and the two sets in series.

oo

L. A. Kern, Mattoon, Ill.

Ques. 1. Is the hot wire ammeter reading taken in the aerial or the ground circuit used as a standard?

Ans. 1. A hot wire ammeter should always be put in the ground circuit and of course, this means a standard reading. The reason is that at the free end of the aerial, the voltage is at a maximum and the amperage approaching zero. While at the ground connection, the opposite is true, i. e., the voltage is approaching zero while the amperage is at a maximum. Since we want the amperage reading, we put the meter where the greatest current flows.

Ques. 2. What size copper strip would you advise for use on a pancake oscillation transformer of one Kw? My present one employs half inch strip in the primary and 3/8" in the secondary. Do you consider this too small for maximum efficiency?

Ans. 2. Would advise you to increase the primary size to 5/8" or 3/4" and the secondary to 1/2". If the present oscillation transformer heats up, you can be assured that you are not getting maximum efficiency.

Ques. 3. What is the call and approximate wave length of the Elivese, German station and the Honolulu station when using undamped oscillations.

Ans. 3. Elivese, Germany, is OUI and the Honolulu stations are KIE and KHX. The wave lengths are approximately 9,000; 5,000; 12,000 and 9,000; 11,000 respectively.

Ques. 4. Kindly furnish a diagram of connections and explain the action of the oscillating audion circuit employing variometers which some amateurs use for reception of short waves.

Ans. 4. We expect to publish next month a complete and thorough article which will cover this question in a better manner than we could answer it in this limited space. The article is worth reading and you will find all your questions answered to your complete satisfaction.

What's the Matter with Galena?

By Lloyd Manuel, Associate I. R. E.

Who would not, after once trying it, admit that the three element vacuum detector is the most sensitive device known for the reception of Hertzian waves? The author freely grants this, but makes claim that for pure, unalloyed pleasure one must experiment with the less sensitive detecting devices before one can know the keen delight of the radio game.

I can never forget the keen delight which I experienced when I first copied NAX on a galena crystal, using a single wire, 40 feet high and 100 feet long. It was satisfaction and required much good tuning, much experimenting and a great deal of hard work to get such efficiency from an ordinary amateur set.

On this same antenna, the writer has received the bulk of stations on the Atlantic Coast, his station being located in Rhode Island. Good signals are received from Boston, Fire Island, and Brooklyn; Portsmouth, N. H. comes in strong and Providence Town is occasionally heard from. Siasconsett, Sea Gate, Sagaponack, when in commission, South Welflett, Arlington, Key West, Norfolk, Charleston, S. C., all the Sound steamers of the New England S. S. Company and many other steamers plying between this country and Europe are heard. What more in an evening could one wish for?

I know a young fellow who became very much dissatisfied with the working of a crystal detector so he threw it in the junk heap and went forth with the fixed determination that he was going to have an audion. He was severe in his characterizations and denunciation of mineral detectors in general—galena in particular! He started to save his money to get the audion and while doing so, he chanced to come into the author's station one night. He looked around and liked the looks of things pretty well, but made a big sniff when he noted the galena crystal in the detector holder. He wondered at the absence of an audion.

I hooked up an extra set of phones and had that gentleman busy reading signals from 8 P. M. until 12. Then I showed him how to connect his set for results. He doesn't care now if he never sees an audion. Let me tell you, friends, a galena detector

Continued on Page 186

Pacific Coast District

The following extract is quoted from a communication from our new Western District Superintendents. It gives a good idea of the splendid relay work which can be developed on the Pacific Coast. The District Managers have been able to line these stations up by wireless so with the necessary co-operation the relay routes will easily swing into place:

"We have communicated on 200 meters, sharp, with ½ Kw. on an antenna eighty feet long (total length to apparatus) and fifty feet high, with the following:

6BY and 6CP	Richmond, Cal.	Distance from Los Angeles..... 350 miles
6TR and 6AHN	Alameda, Cal.	Distance from Los Angeles..... 335 miles
6SI	Hayward, Cal.	Distance from Los Angeles..... 325 miles
6BJ	Centerville, Cal.	Distance from Los Angeles..... 315 miles
6WF and 6SR	San Diego, Cal.	Distance from Los Angeles..... 115 miles
6VZ	Bakersfield, Cal.	Distance from Los Angeles..... 100 miles

The following amateurs have notified us that they heard our signals:

		Distance from Los Angeles	Detector
7ZH	La Grande, Oregon	800 miles	Audion
7SP	Pocatello, Idaho	700 miles	Audion
	Reno, Nevada	400 miles	Galena
6WG	San Rafael, Cal.	355 miles	Galena
6RJ	Ione, Cal.	350 miles	Galena
6FX	Larkspur, Cal.	350 miles	Galena
6HN	Pt. Richmond, Cal.	350 miles	Galena

This list includes 25 others at distances varying from 65 to 350 miles. We have heard KIX in Denver, Colo., KIW in Victor, Colo., and 6ZV in Salt Lake City, Utah. These include the most distant ones. We have heard many others within 400 miles.

(Seefred Bros., 6EA).

The Spark Coils--continued from Page 163

AMATEUR RADIO STATIONS OF THE U. S.

District	No. of Stations	Power in Kw	Average Watts per Station	No. of 1 Kw. Stations	Per. of 1 Kw Sta.
First	472	128	271	17	3.6%
Second	602	150.5	250	35	5.8
Third	728	135	185	23	3.1
Fourth	73	15	205	2	2.7
Fifth	75	21	293	8	10.6
Sixth	570	164	287	43	7.5
Seventh	519	83.5	160	23	4.4
Eighth	858	233	271	67	7.8
Ninth	464	200.5	432	50	10.8
Total	4,360	1,130.5	259	268	6.1

This list does not include Special Amateur stations.

Editor's note: For those interested in lists of this kind, this gives a remarkable chance of study. It enables one to formulate some ideas regarding the amateur work throughout the United States. A little investigation shows that the most power is needed where there are the least number of stations. The percentage of stations using one Kw. is also greater in this territory. It shows the gaps are greater and the power rated accordingly.

Relay Work in the Summer

Continued from Page 182

ing summer. During this summer I intend to work on the filling of gaps; also to follow the suggestion of 7BD and have the appointed stations try to develop other stations hitherto unable to do long distance work and give their operators assistance in tuning or designing apparatus."

R. H. G. MATHEWS, Dist. Mgr.

There is a great deal to be said on either side of this interesting question. The difficulties as Mr. Mathews suggests are rather huge and seem utterly impossible. At Headquarters, we seem to think that it would be well to spend the summer in developing more efficient stations and stronger routes rather than to attempt a few half hearted test which would probably fail. Mr. Mathews' suggestions go to show how the League members will be benefited when everything gets working. Let us all get ready to give the big boost which will bring the momentum which will swing our League along.

What's the Matter with Galena?

Continued from Page 184

using a well-made tuner connected with large wire, every joint well made, a good stopping condenser, and a pair of standard phones such as Holtzer-Cabot, Brandes, or Blitzen, will do wonders for your set. Then too, one must be sure to get good mineral; good mineral is an asset and half the battle.

Buglets—I am not running down the audion. It is a wonderful piece of apparatus. With it the writer has heard messages 1800 miles with phones on the table, but I truly think that if one would be an all-around radio man, he should become experienced in the use of a mineral.

So, fellow amateurs, if you haven't the "clinkers" to put up for a lamp, hie yourself to the nearest supply house, get a good piece of mineral, sit down before your apparatus, connect everything securely, put your detector on a heavy base, and you will be surprised to find that your receiving range has increased wonderfully. If you are truly an amateur, your audion will come in time.

Transformation of Energy in a Condenser Due to Changes in Capacity

Continued from Page 164

nected to the earth, no change can be detected. If the plate b is raised a short distance the polarization decreases and the charge on the plate remains unchanged except by conduction due to moisture and leakage. If air is the dielectric, the amount

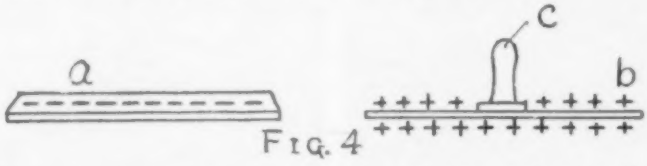

FIG. 4

potential energy increases since the motion is against the resulting force. There is, however, as Dr. Steinmety has shown in his work on "Dielective Hysteresis, a lag in the intensity of polarization behind the intensity of the polarizing force so that induced charges are not reduced to zero as the disc is brought back to its original position. This means that the average value of the force opposing the return is greater than the average value of the force assisting the going in and consequently more work is done in going out than in. As an illustration—if a hard rubber plate were allowed to vibrate on a pendulum between two oppositely charged plates (Fig. 5), it would be found that its rate of dying down increased as a difference of potential between the plates was built up.

It will be noted that the work done is by the force moving the dielectric and that of work done is very small indeed, and the less hot or moist the leakage due to conduction must necessarily be small.

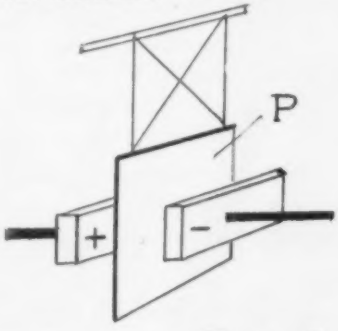

FIG. 5

Latest List of Additions to A. R. R. L. Stations

CONNECTICUT			
Stamford	Theodore Weicker,	79 Prospect St.	1 LO
ILLINOIS			
Chicago	John A. Goorisich	2316 Clybourn Ave.	9 KF
Magnolia	Alvin C. Soencer		9 LJ
INDIANA			
Indianapolis	Richard A. Craig	1807 N. Meridian St.	9 BI
Indianapolis	Leo G. Munchhof	2046 N. New Jersey St.	9 BJ
IOWA			
Delmar	Archie E. Banks	R. R. No. 2	9 AGD
Sioux City	Howard S. M. White	1523 Jackson St.	9 JH
LOUISIANA			
Franklinton	William Macke		5 AV
MASSACHUSETTS			
Arlington Heights	Harold Peterson	154 Westminster Ave.	1 EM
Medford	Hollis L. Gray	29 Vine St.	1 SR
MISSOURI			
St. Louis	George M. Parker	3413 Oak Hill Ave.	GP
NEBRASKA			
Sterling	Prof. E. G. Schalkhausser		9 AHO
NEVADA			
Reno	Willis Pressell	136 Mill St.	6 VI
NEW JERSEY			
Belleville	F. Kenneth Mase	358 Joraleman St.	2 AOA
Jersey City	E. Ray Dimmick	230½ 4th St.	MA
Leonia	Paul F. Godley	106 Leonia Ave.	2 ZE
NEW YORK			
Fulton	Donald K. Ferris	201 Academy St.	DF
Fulton	George W. Mason	165 So. Sec. St.	8 BN
OHIO			
Mansfield	Fred Frey	155 Poplar St.	8 AF
Marion	Marion Radio Club		8 ZD
New Philadelphia	Charles J. Murray	701 W. Fair St.	8 ANZ
PENNSYLVANIA			
Allentown	Roger B. Hernandez	1506 Chew St.	3 LM
St. Davids	M. K. Salen		MS
Scranton	Roy C. Ehrhardt	820 Monroe Ave.	8 TY
West Philadelphia	Albert L. Frankenfield	236 N. 53rd St.	3 JN
TEXAS			
Dallas	Bennett Emerson	3730 Wendelkin St.	5 DU
UTAH			
Salt Lake City	S. H. Besley	171 East 7th St.	6 PA
WASHINGTON			
Tacoma	Clifford Spike	806 So. Eye St.	7 CS

FOR SALE & EXCHANGE

FOR SALE—Arlington Loose Coupler, new $6.00; Type AA crystaloi detector and high speed buzzer, both for $4.00; Brandes Superior Phones, $4.00; 360 ft. No. 14 copper aerial wire, $1.00; small shunt condenser $.25; Will sell complete set for $14.00. All parts are new and in excellent condition. Walter A. Meyer, 1832 No. 13th St., Sheboygan, Wis.

FOR SALE—Mignon RLC4 Special Receiving Cabinet; in first class condition, been in use two months; $65.00 takes this bargain. W. C. Hutchison, Wind Rock, Tenn.

FOR SALE—A limited number of brand new Holtzer-Cabot 3000 ohm receivers. Price $7.00 postpaid. Walter J. Butterworth, 115 Mt. Auburn St., Cambridge, Mass.

FOR SALE—⅛ H. P. 110 volts, 60 cycles, Barnes variable speed motor in perfect condition; fine for driving a rotary gap. The first $7.00 takes it C. D. Tuska, 136 Oakland Terrace, Hartford, Conn.

FOR SALE—A. Ferron detector for sale cheap. Price $2.00. In good condition. William Kohl, 606 St. Clair St., Sheboygan, Wis.

WANTED QUICK—Arlington coupler—fractional Kw. step up transformer—audion—Brandes "S" headset. At once, 5CB, 1012 S., 18th St. Fort Smith, Ark.

Have a new Murdock, $17.50 which I will sell for $15.00. L. G. LaPlant, St. Anthony, Ia.

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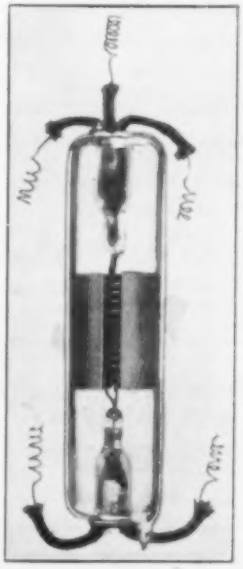

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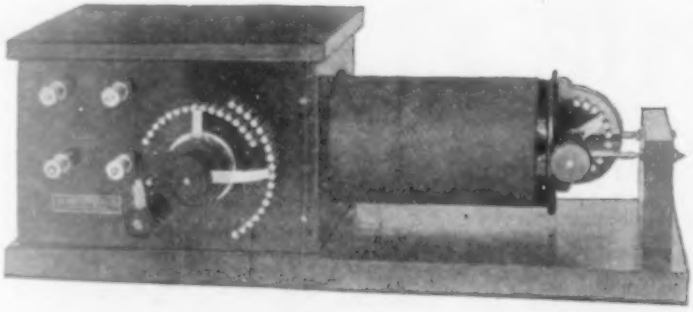

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OUR CATALOGUE FOR 5c

The Radio Apparatus Co.
Pottstown, Pa.

Announcing the Tubular De Forest Audion Bulb

"There is only one Audion-the De Forest"

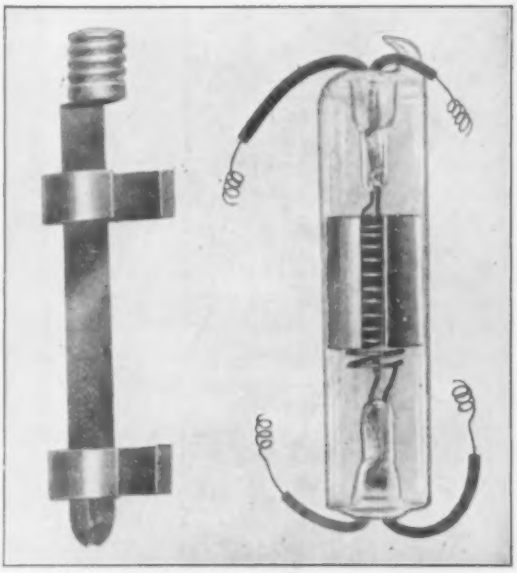
The New Type T Tubular Audion Bulb gives very loud signals from powerful stations. It has a large cylindrical plate, a spiral grid and only one filament of tungsten. As this is a long, straight-line filament, it has a long life. Edison effects are completely eliminated. The plate is in contact with the heavy glass tube, preventing overheating.

Sold Separately, $5.50 each

The special adapter fits this type to the screw base receptacles of De Forest apparatus, and is furnished at 40 cents extra.

Send stamp for Bulletins D16 and B16

The Wireless Mfg. Co.
Canton, Ohio



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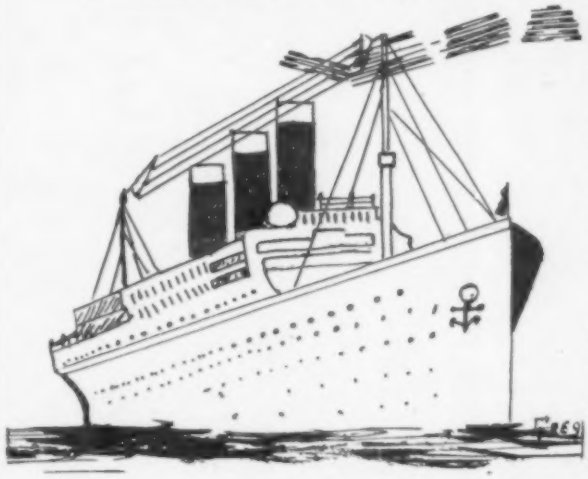

On Board H. M. T. Canastota,
Havre, France, March 21, 1916

To Whom It May Concern:

This is to certify that I took the Course in Radio Telegraphy at the National Radio School, Washington, D. C.

To anyone desiring a First Class Course in Wireless Telegraphy and a thorough understanding of the Principles employed, I can heartily recommend this school.

Signed, Frank B. Illingworth, Radio Officer in Charge.

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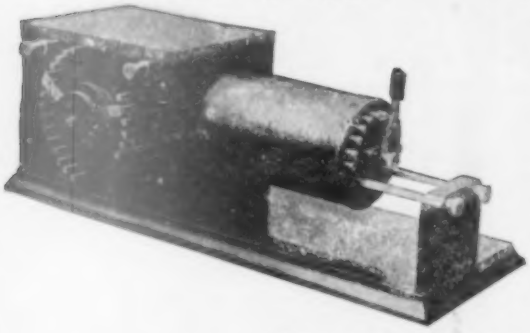

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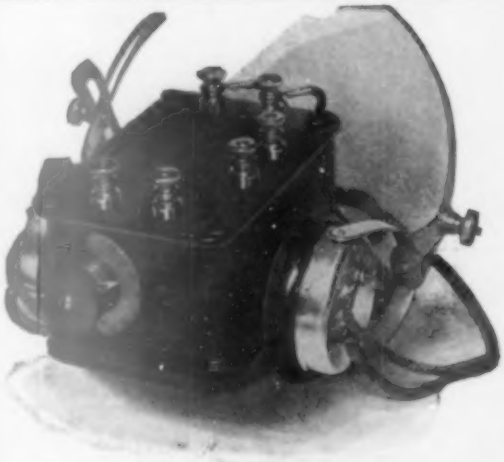

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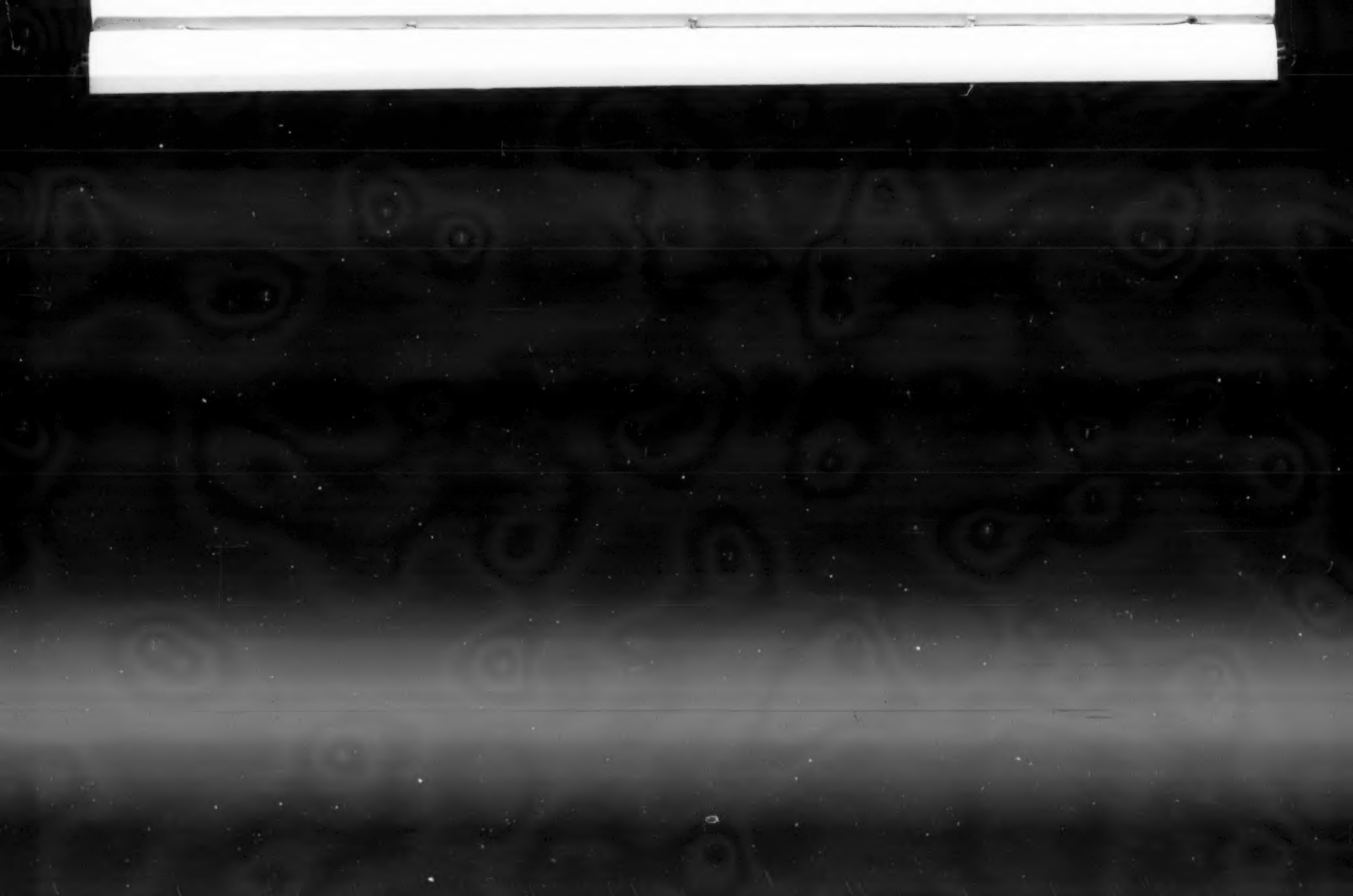

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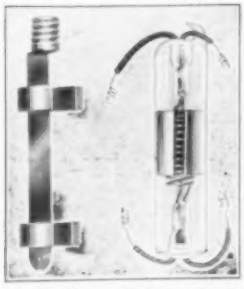
The genuine DeForest Tubular Audion illustrated herewith is now within the means of all amateur operators. It is sold to anyone in any quantity without the return of the old one.

Fully 50 percent. more sensitive than any other known form of detector and thoroughly reliable. Tests show an operating life of at least 800 burning hours when properly used, equal to at least a year's service.

With it the maximum receiving range can be covered. Suitable for receiving arc and spark signals and also for amplifying. Each equipped with a static shunt to prevent paralyzing from static and loud signals. Guaranteed to be delivered to you in perfect condition.



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New Mesco Radio Apparatus

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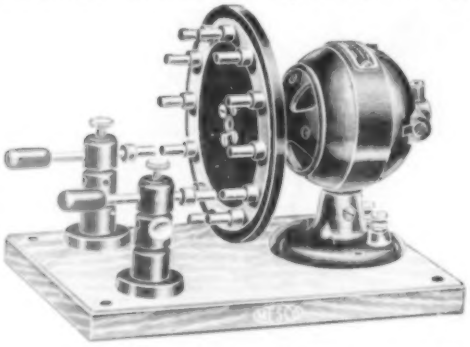

This Rotary Spark Gap emits a high musical note, more audible to the human ear, can be heard at greater distances than the note from the stationary type, and cannot be mistaken for static or other atmospheric disturbances, a fault common with the stationary gap due to its low frequency note.

The rotating member has twelve sparking points mounted on a hard rubber disk and is carried on the motor shaft.

Also fitted with two stationary electrodes with special adjusting devices.

The Gap can be successfully used on any of our spark coils or transformers up to and including 1 K. W. capacity.

Our standard Globe Motor is used, which will operate on 110 A. C. or D. C. circuits and attains a speed of 4,500 R.P.M. Also made with our Globe Battery Motor, which can be operated on a six-volt circuit.

List. No.		Price
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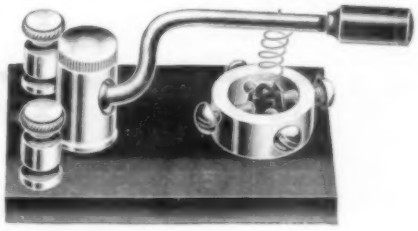
223	Mesco Rotary Spark Gap, 110 v., A. C. or D. C.	13.00
216	Rotary Unit only, with two Stationary Electrodes, 1 3/16 in. shaft	5.00

UNIVERSAL DETECTOR STAND

This Stand has a heavy brass cup, with four binding screws, capable of holding crystals up to and including ¾ in. diameter.

A hollow standard encloses a brass ball. Through an opening in the wall, a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.



A hole for the introduction of different size wires extends through the arm. A set screw in the side of the arm binds the wire.

Supplied with two binding posts. All mounted on a heavy genuine hard rubber base 2¼ x 4½ x ⅜ in. All metal parts nickel plated. A spring rests on the ball in the hollow standard and sets into a cup under the adjusting screw, so that varying pressures can be had as circumstances require. Remains permanently in adjustment under jars and vibrations of every description.

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